Engineering News

Vol. 67, No. 21. 505 Pearl Street, New York May 23, 1912

A Fine Memorial to a Municipal Engineer*

The city of Havana, Cuba, has recently erected the marble monument shown in the accompanying illustration as a grateful acknowledgment of the distinguished services of Francisco de Albear y Lara, who was born in that city in 1811 and died there in the 78th year of his life in 1889. Educated in Spain as a civil engineer, he returned to his native land to become a commandant in the Spanish Army, and was distinguished for his ability in coast-fortification work.

His chief service to his native city, however, was the design and construction of the water-works of Havana. It is to General de Albear that the city owes the construction of the present gravity supply system at the Vento Springs on the Almendares River, nine miles from Havana, which was briefly described by R. Winthrop Pratt in ENGINEERING NEWS of July 14, 1910.

The twin masonry reservoirs or "tanques" at Palatino and the splendid aqueduct from this point to the source of supply are more expressive and enduring monuments in the eyes of his brother engineers than the handsome marble statue in Monserat Plaza. Nevertheless it cannot fail to be a matter of gratification to the engineering profession to know that the citizens of a great city have thus recognized the services of an engineer.

MONUMENT TO GENERAL FRANCISCO DE ALBEAR Y LARA, BUILDER OF THE WATER-WORKS OF HAVANA, CUBA

*From information furnished by James Nesbet Hazlehurst, Consulting Municipal Engineer, Atlanta, Ga.

The Furnishing of Free Engineering Service by Contractors and Manufacturers*

MR. C. C. SCHNEIDER—I wish to call attention to the practice prevailing among contractors and manufacturing establishments of gratuitously preparing plans, furnishing estimates and giving advice on engineering work, thereby interfering with the legitimate practice of the independent engineer. It is my opinion that something should be done to stop this practice, which is certainly unfair and detrimental not only to the engineer, but also to the manufacturer and contractor.

*A discussion at the annual meeting of the American Institute of Consulting Engineers.

As I have had experience both as an engineer in independent practice and a manufacturer of structural steelwork, as a shop man and a mechanic, a few words regarding my own experience may, perhaps, benefit engineers engaged in other branches of the profession, as well as the structural engineer.

In 1886, when I first became connected, as chief engineer, with one of the companies manufacturing bridges and structural steelwork, the prevailing practice of letting contracts was to invite bridge companies to bid a lump sum on a certain structure. The tenders had to be accompanied by strain sheets and preliminary designs which were to conform to specifications furnished by the purchaser. At that time there were only a few engineers in independent practice in that line and, therefore, the designing, with a few exceptions, was done by the engineers in the employ of the manufacturer. As I always believed in doing business on legitimate lines with fair profits, it occurred to me that this method of letting contracts was not fair competition; it was fair neither to the honest manufacturer nor to the purchaser; in fact it prevented the manufacturers from conducting a legitimate business and from giving their customers a square deal.

As the bids were for a lump sum based on designs prepared by the bidder and the one submitting the lowest tender was supposed to obtain the contracts, the designs were naturally not made in the interest and for the benefit of the purchaser. Each competitor would, therefore, endeavor to skin the design. In fact, he would use his skill and ingenuity to make a design which would ostensibly comply with the letter of the specifications as far as the general sections of the members were concerned, but skinned in its details and connections and other points of vital importance which were not clearly covered by the specifications but essential for the strength and permanency of the structure.

Any attempt to make the design conform to the best practice, such as I would be willing to accept had I been the purchaser, involved additional material and, perhaps, more expensive workmanship; therefore, the conscientious manufacturer was always at a disadvantage, and the awarding of a contract under such conditions appeared to me like putting a premium on the poorest design.

Before the time I was interested in manufacturing, I had been in independent practice for several years, and was then employed to prepare designs of structures for railroad companies and other purchasers of structural steel work, and also to pass upon designs made by manufacturers. These designers were not particularly interested, neither did they receive any encouragement from their employers to improve upon their antiquated designs with flimsy, unsubstantial details and connections, which were perhaps best adapted to the limited facilities of a poorly equipped structural shop.

The then prevailing practice, which was encouraged by manufacturers and contractors, of making designs on speculation had its demoralizing influences, which did not seem to be sufficiently appreciated by purchasers of structural work; they being led to believe that the contractor did his work gratuitously.

A moment's reflection, however, will show the fallacy of such an assumption. The fact is that the manufacturer has to pay for making designs not only once, but many times over, as only once in a number of cases is he the successful bidder. The manufacturer would naturally add this extra expense to the cost of the structure, yet the designs were made solely in his own interest and not in that of the purchaser.

This same practice applied to architectural work would mean that a man intending to build a house would write specifications, give the size and general arrangement of the rooms and invite a number of contractors to furnish designs and bid on the designs they submitted, the contract being awarded to the one who submits the lowest lump sum bid on his own design. I know it to be the practice among architects to exclude contractors who make designs for buildings from bidding on their work.

As I became disgusted with being a party to this method of bidding on contracts for structural steelwork, I tried to find some way by which these objectionable and vicious practices might be eliminated. It occurred to me that if the purchasers, such as railroad companies, who employed no engineers who had experience in designing structures, and who were not willing to employ outside experts to make their designs, could be induced to let their structural work on a pound-price basis, without requiring bidders to submit competitive designs, it would be a step in the right direction. This method of letting contracts would not only remove incentive on the part of the manufacturer to skin the design, but reduce the cost to the purchaser, as the contractor would not be put to any expense in making his bid. This would be fair competition, as all would bid on the same basis.

Hoping to convert those who had the letting of contracts to my views, I started out to do some missionary work in this line, explaining to engineers and managers of railroad companies and other purchasers of steel structures the advantages of the method of letting contracts for structural steelwork on a pound-price basis, on designs and specifications furnished by an experienced engineer employed by the purchaser, and recommending it as the only fair and business-like practice. I also pointed out to the purchaser the advantage to him of employing an engineer who would naturally protect his interests, study the conditions and requirements, and design a structure to suit the needs of his client.

I am glad to be able to say that my endeavors have had some good results. Before I severed my connection with the manufacturing company with which I was at that time connected, the practice of letting contracts for structural work had almost entirely changed, and most of the work which was obtained by our company was on a pound-price. It is now becoming more and more the practice to let contracts for bridges and other structures on designs prepared by engineers employed by the purchaser.

In former years most of the structural steelwork for buildings was designed gratuitously for the architect by the manufacturer, while now architects generally employ competent engineers or are associated with engineers in important building construction, and almost all large railroads have their own bridge or structural department, or for work of unusual magnitude employ outside experts to design and supervise its construction.

What is left of the practice of having manufacturers or contractors furnish designs in this line of engineering is practically confined to small structural work and, perhaps, reinforced-concrete construction. At the present time the reinforced-concrete practice is in about the same condition as that of structural steelwork was thirty years ago. A great deal of reinforced-concrete work for buildings is let on a lump sum bid on designs furnished gratis by the contractor, and the one who has the least conscience and the most experience in skinning will naturally obtain the contract. I regret that some of the designing of reinforced-concrete construction for buildings at the present day is done by inexperienced or unscrupulous men.

The designing of structural work of buildings should be entrusted to the experienced specialist only, and publications which pretend to instruct the inexperienced to make structural designs without the proper knowledge are detrimental to the interests of the owner as well as to the engineer.

There are now a number of books in circulation containing empirical rules, tables and formulas, whose object it is to enable those who have no knowledge or experience in structural designing to prepare such designs with the least amount of work and without the knowledge of mathematics, mechanics or the fundamental principles of engineering. Such publications, if put in the hands of inexperienced men, are dangerous expedients, productive of mischief, as has already been demonstrated in many cases which have come to my knowledge. The

publication and distribution of such literature should, therefore, be discouraged.

I think there should be the same distinction between engineers and manufacturers as now exists between the architect and the contractor. The manufacturer should confine himself to his legitimate field of manufacturing structural steelwork at so much a pound, and devote his energies to improvements in tools and machinery and methods for handling material.

In reference to the relations of the contractor, manufacturer and engineer in other lines than structural engineering, I think a policy should be pursued similar to that followed by me in my endeavors to bring structural engineering and manufacturing on a legitimate basis. When I was advancing my views in favor of employing engineers for engineering work, I was connected with a manufacturing concern and my arguments could not, therefore, be considered as coming from an interested party.

I further supported my views by repeatedly refusing to work up proposed schemes on speculation, and on the promise that my company would secure the contract if the scheme proved successful, as not being the legitimate work of the manufacturer but belonging to the independent engineer, who should be paid for his services.

I would, therefore, recommend that this subject be taken up and discussed with manufacturers and contractors in other lines who are now interfering with the legitimate practice of the independent engineer. I think if the advantages they would gain would be pointed out to them, they could be induced to refrain from practicing engineering, or in cases where this cannot be entirely avoided, to demand for their services the same remuneration as if they were practicing engineers.

MR. L. B. STILLWELL—I have been greatly interested in what Mr. Schneider has just said, regarding the unjust competition which certain manufacturing corporations bring into the field of the consulting engineer by performing, without charge, services which can be as well, or better, rendered by the consulting engineer.

In the electrical field this competition is increasingly in evidence. Some of the great corporations which supply electric apparatus have developed departments which, in the endeavor to secure business for their respective companies, do a great deal of work in preparing preliminary plans, estimates and specifications for the electric equipment of railways, for power plants, lighting plants and other aggregations of apparatus manufactured by themselves and others. This service is rendered generally without charge to the client and its cost to the manufacturing company is charged to profit and loss, or advertisement, or exploitation, or engineering—a practice not only grossly unfair to the consulting engineer but improper by reason of the fact that it imposes upon the actual purchaser of the company's product the expense of investigating other people's projects which are never carried out.

Higher officials of each of the three great corporations manufacturing electric apparatus in the United States admitted to me, when as president of the Institute of Electrical Engineers I brought this matter to their attention two years ago, that the practice was expensive to their companies and unfair to consulting and constructing engineers. They pointed out, however, the undoubted fact that much pressure is brought to bear upon the manufacturing companies by prospective purchasers of equipment and claimed in effect that competition compelled their companies to do a certain amount of work which, theoretically at least, belongs to the engineer in the field.

They might have pointed out also the fact that many engineers who undertake consulting or constructing work, or both, are not properly qualified to perform such work. While it is a regrettable fact that much so-called engineering work outside the manufacturing companies is inadequately performed, it is also true that the estimates and preliminary plans and specifications as frequently prepared by the manufacturing companies are inferior as regards accuracy and engineering merit to the work of our better equipped consulting engineers and engineering-construction companies. For example, I have seen a considerable number of estimates and plans for electric equipment of railways as prepared by manufacturing companies at no inconsiderable expense, and I have yet to see one that was even approximately accurate in its estimate of cost or properly comprehensive in its scope.

My idea of the remedy for the very unfortunate state of affairs now existing is as follows:

(1) The American Institute of Consulting Engineers, The American Institute of Electrical Engineers and our other national engineering societies whose members undertake work of this character, should adopt a schedule of minimum charges so far as the service rendered can be classified.

(2) The companies manufacturing electrical apparatus in furnishing estimates, plans and specifications relating to aggregations of apparatus constituting plant or equipment should regard themselves as consulting engineers, and invariably should exact for the service rendered at least the minimum charge recommended for its membership by the engineering societies.

(3) Consulting engineers who secure from manufacturing companies such estimates, plans and specifications as I have just referred to should pay the manufacturing companies for them just as any unprofessional inquirer would pay under the plan suggested.

Chrome-Vanadium Steel for Crosshead Keys will be used in future by the American Locomotive Co. This was decided as the result of a test made by Mr. Hunnings, Chemist and Engineer of Tests of that company, in which the following results were obtained:

Elastic limit	96,800 lb. per sq.in.
Tensile strength....	108,450 lb. per sq.in.
Elongation in 2 in..	20%
Reduction of area...	54.4%

The keys are drop-forged, and are required to meet the following specifications:

Elastic limit not under	80,000 lb. per sq.in.
Tensile strength...	90,000 to 125,000 lb. per sq.in.
Elongation in 2 in. not under	20%
Reduction of area not under	50%

In the test made by Mr. Hunnings, one of these keys ¼ in. thick was bent cold flat on itself without fracture.

The Elimination of Sulphur Gases from smelter fumes is reported in tests of an experimental plant at the Campo Seco smelter of the Penn Mining Co., in Calaveras Co., Calif. The plant operates on the so called "thiogen" process developed by Prof. S. W. Young, of Leland Stanford University. All available details of the tests are given in the "Engineering & Mining Journal" of May 4, 1912. The operation of the plant and process is simple and interesting; the smelter fumes at proper elevated temperature are caused to mix thoroughly with hydrocarbon vapor from oil spray. The hydrocarbon reduces the sulphur oxides to elementary sulphur, which, however, has to be condensed to the plastic or solid form by a reduction in temperature. The plant at the Penn smeltery was only temporary; it comprised a brick flue 40 ft. long, 6 ft. high and 7 ft. 4 in. wide, together with a condensing chamber 10 ft. high and 10 ft. square, and a second flue 10 ft. long, 6 ft. high and 4 ft. wide, leading to a 3x65-ft. smokestack. The 40-ft. flue, which receives the smelter gases directly from the roasters, has transverse panels of brick checkerwork, the openings in which are filled with broken pieces of a mixture of plaster of paris and sawdust. The sawdust burns out, leaving the plaster porous, and this furnishes a contact material to expedite the reaction between hydrocarbon vapor and sulphur oxides. The condensing chamber has a single partition baffle wall and discharges to the second flue leading into the stack.

The whole apparatus is heated to a low red heat before gases are sent through. Oil is sprayed into the hot gases near the roaster intake, and water is sprayed through the roof of the condensing chamber. It is reported that by the time the gases have reached the condensing chamber there are no appreciable quantities of the sulphur oxide. Contact with the cooling spray causes the sulphur to condense, most of it being deposited in plastic form on the floors of the condensing chamber, but considerable quantities are carried out of the smokestack as the finely divided "flowers." Patents of the process are controlled by the Thiogen Co., of which C. R. Miller, of Wilmington, Del., is president and J. T. Overbury, of San Francisco, is secretary and treasurer.

Foreign Street Railway Construction

This paper gives a review of many interesting details of foreign street railway practice. It includes the rails and rail joints, substructure, paving, drainage of tracks, construction of tracks on city bridges and the repair work on existing tracks.

In the development of street railways in large cities, the rapid growth of traffic, together with the introduction of heavy cars and the increased stringency of the requirements of municipal authorities as to paving, etc., has led to important developments in track construction in order to secure the necessary permanence and stability. At the same time, economy in maintenance and renewals has been kept in view, owing to the difficulties of carrying out repair work on tracks in streets having a heavy traffic of cars and ordinary vehicles. These conditions of development have taken place in Europe, as well as in this country, and as foreign practice may well present some ideas of value to American engineers, we give herewith some information regarding certain features of foreign practice. This information is taken from two lengthy papers prepared for the International Tramways Congress,* by Charles Rochat, of the Geneva Electric Railway Co. (Switzerland), and A. Busse, chief engineer of the Great Tramways Co., of Berlin (Germany). We have made no attempt to present these in full, but have condensed and compiled such of the matter as is likely to be of interest and use to our readers.

Rails

Most of the large street-railway lines in Europe use for their urban tracks grooved rails rolled in a single section, but some use rails built up of several parts. Various reasons have led the railway engineers and rail makers to reduce the number of rail sections and to adopt standard sections. This will enable mills to roll for stock, so that railways will have no delay in getting rails, and as all the rails have heads of the same section it will be easy to adjust rails of different weights. The German Tramways Association has adopted a set of 12 standard sections: four ordinary grooved rails, 4 grooved rails with reinforced guard for curves, and 4 built-up grooved rails (Haarmann system). These are of the types shown in Fig. 1, with dimensions as in the table at the foot of p. 967.

The height of rail is limited to about 7½ in., as the cost and the difficulty of laying rails embedded in concrete increase with the height. In these German rails, the sides of the guard are inclined 1 in 6; its top is 0.12 in. below the top of the rail head, so that with worn rails the guard will not be higher than the head, and thus interfere with the passage of vehicles. The standard sections do not include a rail with partly filled groove, such as several companies use on curves, as the utility of such a design has not yet been established or generally accepted. Mr. Busse states that several companies continue to use in stone paving rails 7½ to 8½ in. in height; in asphalt and wood paving, however, or where a concrete base is used, rails of moderate heights are preferable (6 to 6½ in.), with flanges as wide as possible (6 to 7¼ in.). In order to reduce the cost, it is desirable to keep the concrete bed or base as thin as possible, and for this reason the Berlin lines have used in asphalt

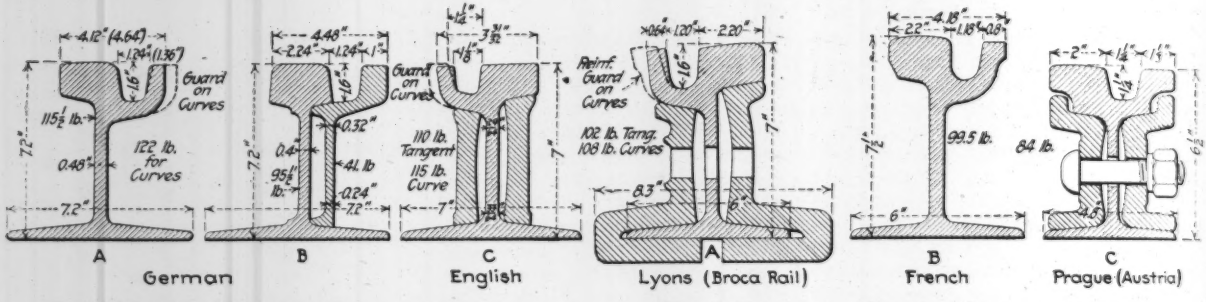

FIG. 1. TYPES OF STANDARD CROSS SECTIONS OF GROOVED RAILS FOR STREET RAILWAYS

FIG. 2. FRENCH AND AUSTRIAN RAILS FOR STREET RAILWAYS

(A) German Rail, (B) German Built-Up Rail, (C) English Rail. The dotted lines show widened groove and reinforced guard for curves

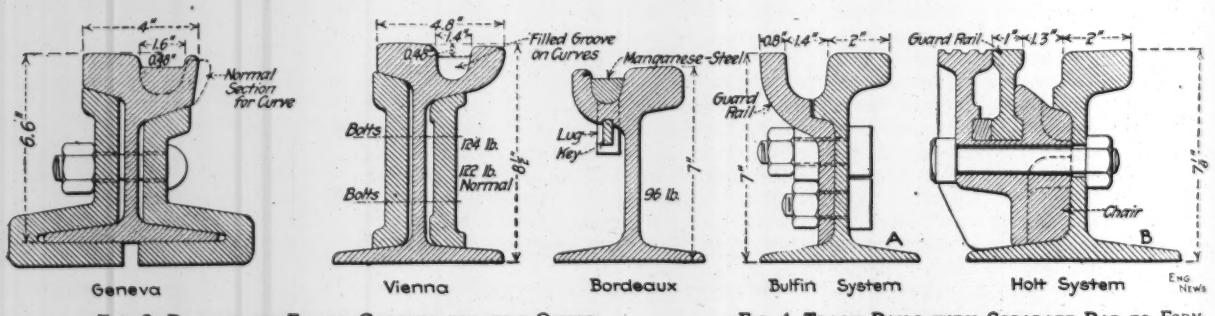

FIG. 3. RAILS WITH FILLED GROOVES FOR THE OUTER LINE ON CURVES

(The two first are rolled to shape; the third has a filler piece placed in the groove.)

FIG. 4. TRACK RAILS WITH SEPARATE BAR TO FORM THE GUARD SIDE OF THE GROOVE

((A) Bulfin System. (B) Holt System.)

*The papers are published by the Union International de Tramways, 15 Rue de la Toison d'Or, Brussels, Belgium.

streets rails only 4 in. high, on ties or longitudinal blocks of reinforced concrete, as described later. This construction has proved satisfactory; the rails hold in line and show no wear in the form of corrugation of the head.

In England also there has been since 1903 a set of five standard sections for grooved rails with ordinary and reinforced guard. These are of the type shown in Fig. 1, with dimensions as given in the accompanying table. Fig. 2 shows the rails of some French and Austrian lines.

The average length of rails is 50 ft., but there is a tendency to increase this in order to reduce the number of joints; these lengths are 60 to 65 ft., or even 78¾ ft. on the East Paris line. There is a limit to the length, determined by the extra price and by the difficulties of transportation and handling. These difficulties will be considerations of special importance where the lines are in narrow or crooked streets. One of the 78¾-ft.,

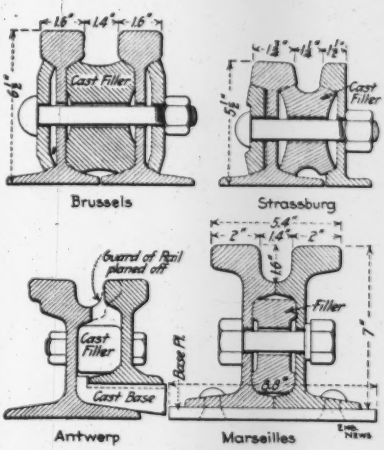

FIG. 5. BUILT-UP RAILS FOR CURVES ON STREET-RAILWAY TRACKS

public, especially as of late years the life of ordinary rails has been decreasing. Such experiments are of importance also

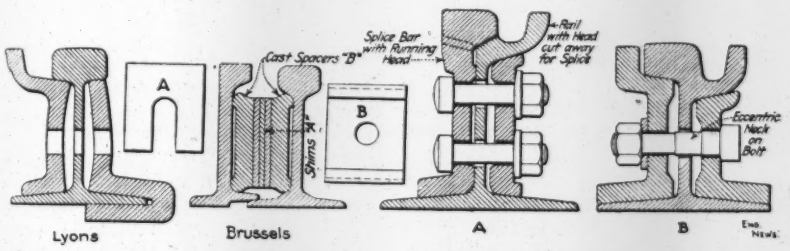

FIG. 6. BUILT-UP RAILS FOR CURVES

FIG. 7. TWO RAIL JOINTS FOR STREET-RAILWAY TRACK

(A. The Melaun Joint, with wheel-bearing splice bar.
B. The Bochum Joint, with eccentric-neck bolts to force the rail ends together.)

92-lb. rails of the East Paris line will weigh as much as 2428 lb.

Mr. Busse states that the rapid wear of rails, even on tangents, is aggravated by undulatory wear or transverse corrugation of the heads. This has led to experiments with metal of high resistance, such as alloy steels of manganese, titanium and nickel, and more especially the first two. He refers particularly to tests of titanium-steel rails on American steam railways, and to experience which indicates that rails of manganese-steel will last 4½ to 5 times as long as high-carbon Martin steel, and 50 times as long as bessemer steel. This last point is deduced from actual service on very sharp curves of the Boston Elevated Ry. Steel produced in electric furnaces is mentioned as likely to give rails of very high quality. It is suggested that electric railways should forward progress in this direction by experimenting with rails of special grades of steel and making the results for the reason that municipalities continue to extend the use of costly paving systems in streets having tracks, so that the cost of maintenance and renewal of tracks increases very seriously.

RAILS ON CURVES

According to Mr. Rochat, opinions vary as to the dimensions to be given to the groove on curves. Most lines increase the normal width to a maximum of 1.4 or 1.6 in., while others maintain the normal width or even reduce it slightly. In general, the advantage of widening is considered as established, but no general principle can be laid down and the practice must be governed by the special conditions of each case.

For sharp curves (below a radius of 98 ft.) there is an increasing tendency to use outer rails having the groove partly filled (to engage the wheel flanges) and inner rails having a reinforced guard. However, while in some cases the use of the filled groove is considered to have reduced the wear of the rails and the noise of the cars passing the curve, in other cases the results have been very different, while the wear of the fastenings is very heavy, so that the use of this sort of rail will not be continued by certain lines. The results will depend in each case upon various conditions of track and rolling stock, such as length of wheelbase, the use of rigid or radial axles, etc. In any case, the rail with filled groove should be used only in connection with a reinforced guard to the groove on the inner rail, so as to take the guiding and wear. The depth of the filled groove should be only a little less than the depth of the wheel flanges, so as not to cause severe shocks as the cars enter and leave the curve; and the filling should taper off easily at each end. Fig. 3 shows the arrangement as used at Geneva (Switzerland), Vienna (Austria), and Bordeaux (France). In the third case, an ordinary rail is used and the groove filling is a strip of manganese-steel which has lugs passing through holes in the bottom of the groove and secured by keys beneath the rail head.

As to the grade of steel for rails on curves, the tendency is to adopt very hard steel or cast manganese-steel, the wear of the latter being very slight. The latter, however, can be obtained only in short lengths*, 14¼ to 20 ft., and cannot be welded. Nickel-steel (with about 3½% nickel) has been used, and also titanium steel and chrome-steel, though this last is too expensive for general use. Several lines are now using for this purpose the silicon-steel or Sandberg rails,

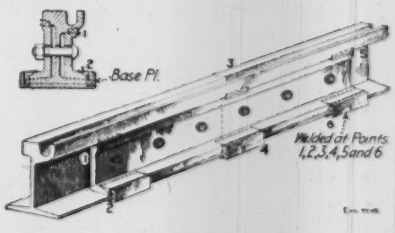

FIG. 8. THE HESSE RAIL JOINT, WITH SPLICE BARS WELDED TO THE RAILS AND BASE PLATES

in which the proportion of silicon is from 5 to 10 times as great as in bessemer or Siemens-Martin steel. This silicon increases the density and homogeneity of the metal, and the wearing quality of the rails is said to be 30% higher, while the cost is only 8 to 10% higher than that of the other two grades of steel mentioned. These silicon-steel rails were first used

STANDARD ENGLISH AND GERMAN RAIL SECTIONS FOR STREET RAILWAYS

English			German				Built-up Rails	
Height in.	Width of base in.	Wt. per yard lb.	Height in.	Width of base in.	Weight per yd. lb.	Wt. with reinforced guard lb.	Wt. of rail lb.	Wt. of guard rail lb.
6½	6½	90	6.0	5.6	85.6	91.4	66.6	30.2
6½	7	94	6.4	6.0	98.4	104.8	79.0	33.2
6½	7	100	6.4	7.2	112.0	119.6	92.4	38.8
7	7	104	7.2	7.2	115.6	122.0	95.6	40.8
7	7	110	...	...	....	....	....	....

*This refers to cast manganese-steel rails only, no mention being made of rolled manganese-steel rails, as produced now in the United States.—Ed.

for street railway work in London in 1907.

A number of lines use independent guards or guard rails on curves, thus allowing of renewal or adjustment of the guard. Some of the designs are shown in Fig. 4. In the Bulfin design (A), made by Edgar Allen & Co., of Sheffield, the guard is in lengths of 3.28 ft., and is bolted to the web of the rail, the guard side of the groove being planed away. The bolts are 8 in. apart and any irregularities in the groove are removed by milling after the parts are assembled. The construction has given good results, but has the objection of requiring a large number of bolts. In the Holt design (B), by the same makers, the guard rail is a shallow bar of I-section; this is rolled in lengths of 20 ft. and is keyed to chairs or brackets which are spaced about 20 in. apart and are bolted to the rail. The guard can be inverted when its upper head has become worn. The greater length of the bar and the reduced number of bolts are advantages in this design, and it can be adapted to any form of rail by varying the shape of the chairs.

Other lines use built-up or compound rails on sharp curves; these may be composed of two T-rails, two grooved rails, or one rail of each kind. The two parts are put together with bolts and spacing blocks about 3¼ ft. apart. The guard side may be of manganese-steel or other hard-alloy steel, and at Lyons (France) it serves also as a splice. Some of these designs are shown in Figs. 5 and 6. For the inside of curves, the Brussels lines use a rail of such form as to permit of shifting the guard toward the main rail to take up wear of the surface (Fig. 6). The spacing blocks are in two pieces, which are separated by iron packing strips slotted to fit over the bolts. As the face of the guard becomes worn, one or more of these packing pieces can be removed and the guard thus moved inward so as to maintain the normal width of flangeway or groove. A similar arrangement may be used with other forms of guard rails which are separate from the running rail. Mr. Busse states that there is a decided tendency toward increasing the use of reinforced guard rails on curves, and also the use of rails of special steel on curves; special steel has been used also for rails having filled grooves (noted above), although the use of such rails is exceptional.

Widening Gage and Superelevation of Rails on Curves

Most street railway lines do not widen the gage on curves, but some do this to the extent of 0.16 to 0.4 in. on curves below 65 ft. radius. A few lines narrow the gage slightly (with grooved rails), at the ends of the curves at least, the object being to have the wear taken by the outer rail head instead of by the guard of the inner rail, which has comparatively little metal if of normal section. At Bordeaux, the gage on curves is widened by 0.08 to 0.24 in., and when the wear becomes pronounced (especially on the guard) the gage is narrowed by 0.4 to 0.5 in.; the outside rail then continues to take the wear, while the guard on the inner rail serves to guide the wheels. The general reason for not widening the gage is the rapid wear of the guard on

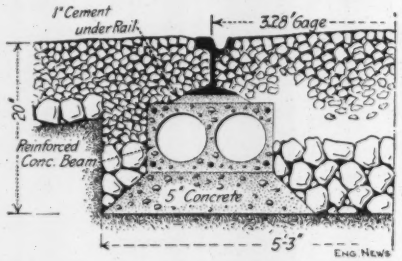

Fig. 9. Half Cross-section of Street-railway Track with Hollow Concrete Stringers; Geneva, Switzerland

the inner rail. The width of groove is sometimes increased on curves. Mr. Rochat believes that the advantages of widening gage are evident, and that the best practice is to use for the outside rail a grooved rail with groove filled and widened, and to give the inside rail a reinforced guard, both lines of rails being of hard or alloy steel. Mr. Busse,

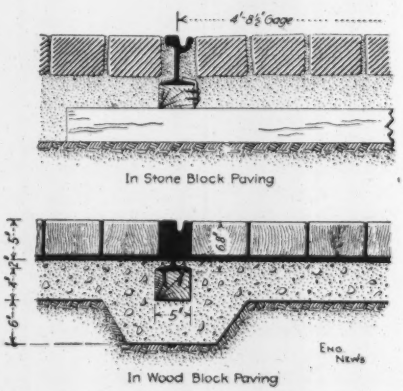

Fig. 10. Half Cross-section of Street-railway Track Construction at Paris, France

however, considers that the benefits of the filled groove have not been proved.

The superelevation of the outer rail is desirable, but in paved streets it is often impracticable. The track must be adapted to the prescribed cross-section of the street, and in fact this section is sometimes such that the outer rail is actually lower than the inner rail. The filling of the groove (as described above) accomplishes the purpose to some extent, but is usually too small to be of much effect. The elevation may be given on the outer rail alone, or by lowering the inner and raising the outer rail. The maximum is 4 in., but in general it is from 1.6 to 2 in.

Rail Joints

The ordinary type of splice joint is often of insufficient rigidity but much has been done to strengthen it, the improvements including the use of larger bolts and means for preventing the slackening of the nuts. It is very generally used in England and America, usually with 1-in. bolts; six bolts are the minimum, and with 8 to 12 bolts they are placed in two rows and staggered. The Bochum joint (Fig. 7) presents some important features. The rail is upset slightly at the ends to give greater height to the head and greater thickness to the base. Each bolt has an eccentric neck which fits in the rail hole, this eccentricity being about 0.08 in. A mark on the head shows the proper position for the bolt when placed in the hole. The nuts are screwed up lightly, the nut locks and splice bars are tapped lightly into place with a hammer, and then the bolts are turned (by their rectangular heads) so that the rails are forced together by the action of the eccentric necks. This has been used as yet to a limited extent only.

The flange joint, which embraces the edges of the rail base and the web gives good service when rolled carefully to fit the rail base, and when carefully applied. Another joint which has given very good results in service is the wedge joint.* This has a base plate with curved sides extending over the top of the rail base, and on each side a wedge or key is driven between the rail and plate, bearing against the web and the top and edge of the base. The following advantages are claimed: (1) the rails are held rigidly in the same line and level, (2) no bolts are required, (3) the joint is easily applied by the regular trackmen, (4) in case of rail fracture the parts are readily held by the application of this device, and (5) the expenses of maintenance are low. It gives sufficient contact and conductivity to enable electric bonds to be dispensed with, but a copper bar may be placed in a groove in the rail seat to assist the conductivity, the base of each rail being cleaned at this point when the joint is applied or adjusted. This joint has been used on a large number of roads and is considered by Mr. Rochat as a good solution of the joint problem.

The Melaun joint, used in Germany and Austria, consists of a heavy splice bar whose upper edge forms the running head, the rail head being cut away edges of the rail base and the web, gives to admit it, and the head of the splice bar resting on the webs of the two rails. This also is shown in Fig. 7, as adapted to a grooved rail. It makes

*Engineering News, May 27, 1909.

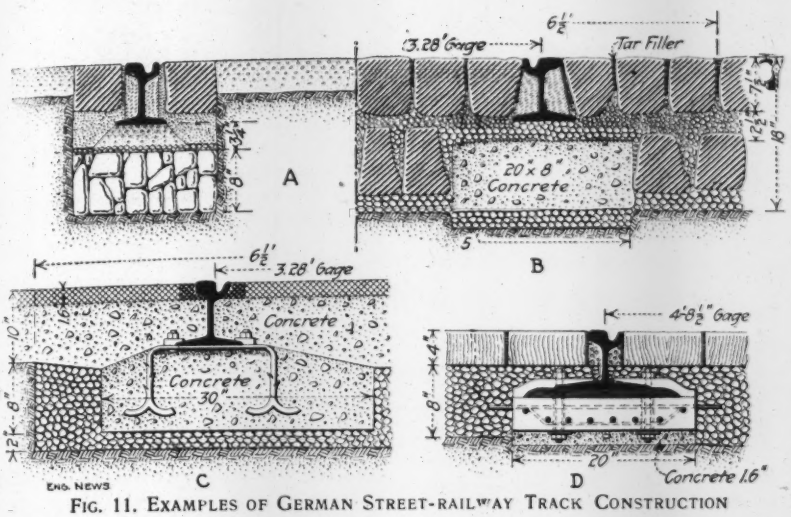

FIG. 11. EXAMPLES OF GERMAN STREET-RAILWAY TRACK CONSTRUCTION

(A) Nonrigid construction at Duesseldorf and Berlin; (B) Semirigid construction at Neuchatel; (C) Rigid construction at Neuchatel; (D) Construction with reinforced-concrete blocks at Elberfeld and Brunswick.

a very strong connection and is specially adapted for the renewal of worn joints, since the worn part of the rail head is replaced by the metal of the new splice. In fact, it is noted that it is hardly logical to apply it to new rails, as that would mean the cutting away of new metal before it has done any service. The cutting may be done by mechanical means or by the oxyacetylene or oxhydric processes, the burners for the cutting flames being carried on a frame clamped to the rails. The joint has been used on about 1500 miles of street-railway construction and for renewals, and in special form it has been applied as an expansion joint. On the Vienna lines it is considered to be as good as a welded joint, but with the added advantage of providing for removal when required.

The Hesse joint, Fig. 8, has angle splice bars which are so shaped as to have contact bearings with the rail head and base at the ends and middle of the bar only. It is effective in raising low joints and can be applied without interference to traffic. It may exert an upward pressure against the ends of the rail heads by means of a camber in the bar or by means of transverse keys driven beneath the rail base, the ends of the keys resting in holes in lugs at the middle of the splice bars. At Marseilles, a six-bolt splice joint is used, with the rails resting on an iron base plate on a longitudinal timber 6x12 in., 40 in. long; the rails and splice bars are attached to the timber by screw spikes.

The cast-weld joint was used extensively before the electrically welded joint was known, and varying results have been obtained. It requires a special plant for its application, so that it cannot well be used by any except large systems. The work must be done very carefully to insure good results. Some large lines which are equipped continue its use, but otherwise (according to Mr. Rochat) its field does not increase but appears rather to decrease. It is used at Paris, Antwerp, Rotterdam and other cities, but very little in Germany. At Brussels its use is continued because the company has its plant and trained staff, but its use is not recommended for track with worn joints; with this plant from 50 to 60 joints can be made as a night's work, at a cost of about $2.50 per joint (without paving).

Electric welding as applied to the direct welding of the rail ends is not generally satisfactory as it has a deteriorating effect upon steel, and both Mr. Rochat and Mr. Busse give preference to the system of welding splice bars to the rails.* The improvement of worn joints by welding on new metal has been tried, but nearly always with poor results. Autogenous welding has been tried on a small scale, but has not proved satisfactory. On the other hand, thermit welding has proved successful both on new and old track, and has been used widely throughout Europe; during the decade 1900-1909 about 286,180 joints were made. The process is said to have been so improved that there is little fear of fracture of the joint and it can be used to bring low joints up to the required elevation. Mr. Busse notes that on the East-Paris line 400 thermit joints were cut out because the results were not as expected, but he says also that where this welding has been done on a large scale it is considered preferable to the splice joint; the life of the track is improved and there is less maintenance work required on the rolling stock.

In regard to the general question of rail joints, Mr. Busse remarks that in relation to the track and its maintenance the rail joint is fully as important as the quality of metal in the rail. Further, it has an important relation to the life of the track and the permanence of the foundation and paving. One feature to be aimed at is to so connect the rails that cars will pass over the joint without shock, so as to reduce to a minimum the wear of the ends of the rails. As a primary consideration there should be as little deflection as possible in the joint when loaded, so that the joint needs to be fully as rigid as the rail. It is equally necessary (to insure easy riding of the cars) that there should be no vertical or lateral displacement of the rail ends in relation to each other. The earlier forms of splices have proved defective not so much on account of their construction as on account of the fact that the metal of the two rails has often a different degree of resistance so that

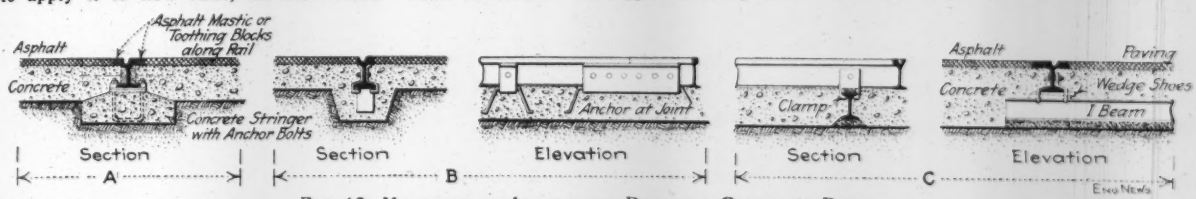

FIG. 12. METHODS OF ANCHORING RAILS TO CONCRETE BASE

(A) Anchor bolts; (B) Clamps and anchor saddles; (C) Clamps and I-beams.

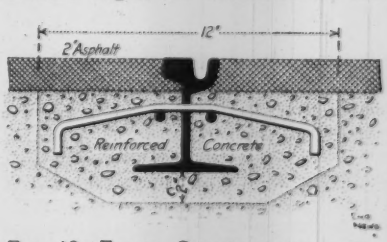

FIG. 13. TRACK CONSTRUCTION WITH MONOLITHIC REINFORCED CONCRETE AT NUREMBURG (EISIG SYSTEM)

*The Lorain system of splice welding was described in Engineering News, Sept. 1, 1910, and the Gaylor system, Aug. 31, 1911. The latter is not unlike the Hesse joint noted above, but has welded contact with the rail base and head for the entire length of the splice. —Ed.

there will be unequal wear even with very carefully made joints.

The absence of decisive information upon the joint problem may be attributed largely to a lack of care in the construction or splicing of joints in actual practice; this is due principally to the fact that municipal authorities require the companies to hasten their work so as not to interfere too greatly with the general traffic. Thus in asphalted streets the tracks are laid sometimes on a base of concrete that has not fully set, and then are immediately buried in concrete and put in service as soon as the paving is laid. Under such conditions it is not possible to obtain a rigid and noiseless track, or joints that will keep in good condition. Nevertheless, great progress has been made in joint design, and complaints on this feature of track construction are much more rare than formerly. This condition is considered due in large measure to the almost universal practice of laying the rails in close contact, as rails buried in the paving are less influenced by temperature changes and being held by the paving they have less variation in length under such changes. However, expansion joints are often used in track having welded joints, as noted below. In any case, for tracks in asphalt paving it is necessary to provide expansion joints at intervals, for experience proves that the joints and the adjacent portion of the paving are destroyed in a very short time.

To insure high resistance in the joint, Mr. Busse advocates a more extended use of nut locks, and approves of a form of nut lock made by the Bochum Steel Works. This consists of a curved spring plate with its convex face against the splice bar. For a four-bolt joint there may be two plates, each bored for two bolts; or there may be three plates. With the latter arrangement, each end plate has one hole for a bolt while its opposite end is slotted or notched to fit over the next bolt; the middle plate has both ends slotted. The Schoenig-Hoffman and the Ambert joints of the base-plate type are mentioned by Mr. Busse. The first has been applied in several cases and generally with good results. The latter has been tried on four lines, but with varying results. As to rail bonds, he suggests the desirability of adopting a uniform length so that the holes in the rails can be made at the mills.

EXPANSION AT JOINTS—For tracks embedded in the earth or paving (as noted above) it is not usual to allow any expansion spacing at the joints. This is not found to present any inconveniences, while the advantages are great; and if the splicing is rigid this method avoids the hammering which is so injurious both to the track and the rolling stock. Some lines give a certain spacing at connections to forge and switches, while others give a slight opening at joints in rails laid in winter. Some roads using welded joints provide expansion joints at intervals, these intervals being given by Mr. Rochat as 328 to 656 ft. and by Mr. Busse as 230 to 1640 ft.

TRACK SUBSTRUCTURE

The substructure for street-railway track may be either elastic or rigid. For the former, the most general plan is to

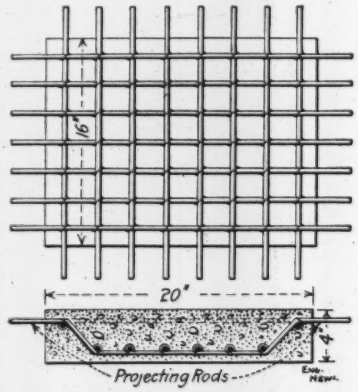

FIG. 14. REINFORCED-CONCRETE BLOCKS FOR STREET-RAILWAY TRACK (REINHARDT SYSTEM)

use a bed of broken stone 6 to 10 in. thick (and finished to the curved contour of the street), on which is a layer of ballast 3 to 4 in. thick. This method permits the infiltration and escape of surface water. It is employed with success when the street is macadamized or paved with stone. The rigid substructure has a base of concrete which either forms longitudinals under the rails or extends the full width of the street. Mr. Rochat considers that this gives a hard riding track and is open to the objection of not being permeable. As the connection between the rails and the paving cannot be maintained watertight, water will enter and will eventually cause disintegration of the concrete. (See later note on Drainage of Tracks.) This type of construction is employed nearly exclusively for streets having asphalt or wood-block paving. Engineers have tried to find a

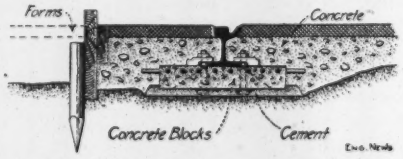

FIG. 15. TRACK CONSTRUCTION WITH REINFORCED-CONCRETE BLOCKS

system combining a good relation of the track to the paving with facility for renewing rails, but thus far without distinct success.

Experiments have been made with blocks of reinforced concrete placed under the rails, partly to secure a good relation between the track and the concrete foundation of the street and partly to permit a rapid laying and readily renewal of the rails, while limiting the width of trench or cut to the minimum. Sometimes these blocks or plates are flat; others have a groove to receive the rail, which is secured by through bolts. The space between the rail and the sides of the groove is filled with asphalt. At Geneva, the rails are placed on hollow beams of reinforced concrete which rest on the foundation concrete and provide for drainage along the rails. As shown in Fig. 9, these are 8x14 in., with two holes 1.6 in. diameter.

Fig. 10 shows the construction used in Paris with stone and wood block paving. The rails are on oak longitudinals supported by cross ties embedded in concrete; the timbers are the same width as base of rail, and the rails are secured to them by small screw spikes. The ties are from 3¼ to 5 ft. apart, according to the conditions of weight of equipment and amount of traffic. At first, with wood paving, the rails were more or less embedded in the foundation concrete, but owing to lack of elasticity this soon broke loose from the rails. Plates of felt laid between the rails and the concrete soon disappeared by decay and

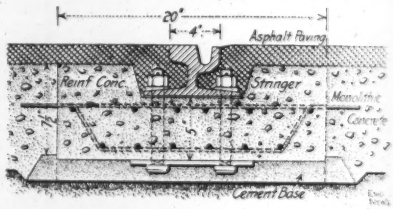

FIG. 16. TRACK CONSTRUCTION WITH REINFORCED-CONCRETE LONGITUDINALS AND SPECIAL SHALLOW RAILS, BERLIN

wear, and the plan illustrated was adopted as preferable. Fig. 11 shows some other systems of construction.

Where the tracks must be laid in concrete and asphalt paving, improved methods of construction have been tried. All of these are based on the fact that the loosening of the rails embedded in the concrete may be prevented or at least reduced when the rails are supported on iron plates, chairs, wood or reinforced-concrete blocks, ties or other devices, and when they are anchored with these supports in the concrete. One method, used extensively for some years, consists in fastening the rails by clips and nuts on stirrups or U-bolts embedded in the concrete (Fig. 12). At Dresden, Mr. Klotte uses anchors of inverted trough form (similar to the base supports at the rail joints); two short splice bars clip the top of the anchor and are secured to the rail by a single bolt (Fig. 12).

At Berlin, some of the municipal lines built in 1908 have a full base of con-

crete in which are embedded steel ties of 6-in. I-beams, spaced 13.12 ft. apart or 6.56 ft. at the rail joints. As shown in Fig. 12, the grooved rails (6.2 in. high) are secured to the ties by clamps which grip the top flange of the tie and are secured by a bolt through the rail. This appears to be satisfactory, but it is anticipated that there will be difficulties when

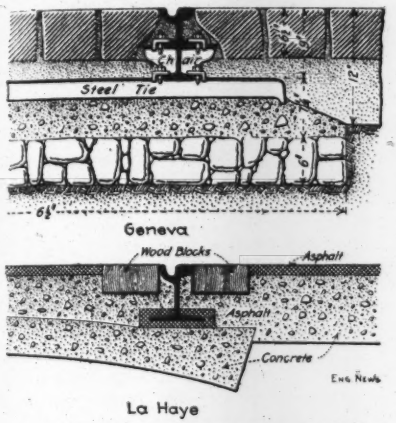

FIG. 17. STREET-RAILWAY TRACK CONSTRUCTION AT GENEVA AND LA HAYE

it becomes necessary to readjust rails and ties which have become loose, as this will necessitate breaking up and relaying the concrete base. In the Eisig system, employed at Nuremberg and shown in Fig. 13, the rails are not embedded in the concrete of the pavement, but each rail is embedded in a concrete beam which is reinforced by longitudinal rods (near the head of the rail) and by transverse rods 6 to 8 in. apart. Any repair work would be very difficult and very costly, but it is hoped that the support will last as long as the rails.

In most systems of concrete construction, time must be allowed for the concrete to set, but in large cities it is rarely possible to allow track to remain unused for a sufficient time. The Reinhardt system of supporting the rails on blocks of reinforced concrete has been used at Berlin and elsewhere with success. It permits of securing the rails firmly and putting them in use with very little delay, without loosening the attachments. The system has been used for new construction and for relaying old tracks torn up from the concrete base.

The blocks are 16 to 20 in. square and 4 in. thick (Figs. 14 and 15); they are made in advance and are thoroughly set and hard when used, so that the rails can be attached to them at once. They are placed 3¼ to 4½ ft. c. to c. The rails are laid upon them, lined in position and secured by bolted clamps; previous to this the bearing surface for the rails is covered with a hot bituminous mastic. When the blocks are 1 to 1½ in. too thin for the depth of concrete in the street base, they are bedded on cement

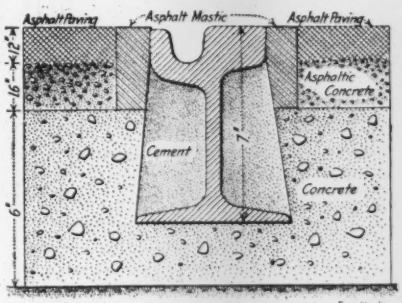

FIG. 18. GIRDER RAIL IN CONCRETE BASE WITH ASPHALT PAVING, BORDEAUX (FRANCE)

mortar or dry concrete. When the track is to be used at once, the blocks are raised by means of asphalt bedding. It is necessary to have the tamping properly done and the rails securely bolted. As the reinforcing rods project from the blocks, the latter are fully bonded to the surrounding mass of concrete and cannot become loose.

In this system, however, the renewal of tracks will involve considerable difficulty and expense. In order to eliminate the direct contact between rail and concrete, and to permit of renewing rails without destroying the concrete base, a modification devised by Mr. Busse and Mr. Reinhardt provides for the use of longitudinals of reinforced concrete. The present system of making the tracks very rigid and enveloping them in non-elastic concrete has been abandoned; the noise due to the passage of cars is reduced by isolating the rail from the concrete by a layer of asphalt. The height of the rails is reduced materially (4 in. with a 7¼-in. base width), since the rails have a continuous support and are not subjected to bending or deflection. The high and heavy rails are necessary with stone paving construction, but not with asphalt or wood.

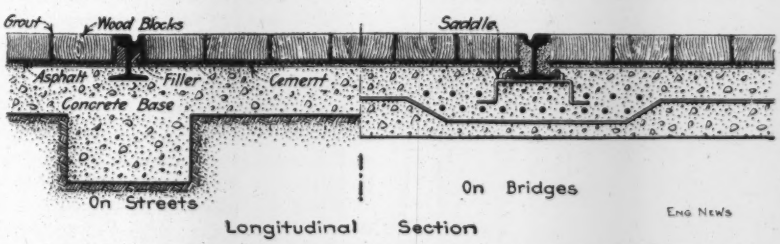

FIG. 19. STREET-RAILWAY TRACK CONSTRUCTION AT GENEVA (SWITZERLAND)

In this system as used at Berlin (Fig. 16), the longitudinals are 3.28 ft. long, 20 in. wide, 5 in. thick under the rail and 7½ in. at the sides. The rail seat is coated with asphalt before the block is placed under the rail. The space between the blocks and the subgrade is carefully filled with concrete. Liquid cement grout is poured into the bolt holes, and the spaces between the rails and the sides of the block are filled with a bituminous composition, which serves also to exclude water. No transverse connections of the rails are used, as these have been found unnecessary. The sides of the longitudinals are well bonded to the adjacent concrete of the street base by the projecting reinforcing bars. To renew a rail, it is only necessary to remove the composition along its sides, and to unscrew the nuts of the anchor bolts. Worn or loose bolts can be removed when necessary. For curves, blocks with a greater width of rail seat may be used, but special blocks are required for switches and turnouts. A slightly different form of block is used with wood paving. The rail joints are welded. Base plates of reinforced or protected felt are being tried under the rails.

A track designed by Mr. Kopcke and Mr. Bloss, of Dresden, employs ties of reinforced concrete, which are of a design modified from that of the Italian State Railways. The ties are 6 ft. long (for meter gage track), 5½x8 in. at the rail seat, but with the top width reduced to 2½ in. between and outside of the rail seats so as to reduce the weight. There are four reinforcing rods at the top and seven at the bottom, these being connected by vertical transverse stirrups. Horizontal lateral bars extend under the top longitudinal bars. The concrete is a 1:2½ mixture, using sand and broken stone, and the ties are allowed to set for at least three months before using. The total weight of the tie is about 210 lb. The screw spikes are fitted to beech plugs of tapering form embedded in the concrete. Treated oak blocks, 3¼ in. thick, are placed between the tie and the rails. The ties are laid 3:28 ft. apart on a base consisting of 6½ in. of large stones, and a 2½-in. top layer of small stones. The track so far is very satisfactory; it is noiseless and easy riding and there is no settlement of the ties under traffic loads.

PAVING THE TRACKS

In Mr. Busse's paper it is stated that with the rapid increase in the use of asphalt and wood paving, the street railways have to encounter not only an increase in maintenance cost but also an increased difficulty in keeping the paving along the rails in good condition. At

Berlin, however, some of the suburban districts have decided that tracks in asphalted streets may be paved with ordinary materials. Four years' experience has shown that this has not only reduced the high cost of track construction in asphalt streets, but has avoided the long interruptions to traffic resulting from the frequent repairs to the asphalt paving along the tracks, and the time necessarily allowed for the new concrete to set. The tracks laid in this way during the four years required no repairs either to the stone paving or to the joint between the stone and asphalt paving.

An objection was made that residents would be annoyed by the noise of street vehicles passing upon or crossing the stone-paved portion of the street; but this has been found to be of very little importance. In fact, when the track is laid with asphalt on concrete, a greater noise is caused by the cars; this is due to the resonance of rails embedded in concrete, especially when the rail wear takes the form of corrugation. Objections as to the bad appearance of two kinds of paving in the street are considered of little importance. If the experiments with bituminous macadam give good results, this material may be employed with advantage; it is cheaper than first-class stone paving, while the passage of vehicles raises no dust and causes no noise. It is possible also that this material may be used instead of cement concrete for the foundation. The experiments are being made with the Aberli macadam, in which coal-tar is poured on the stone, covered with sand, and then mixed. The resultant material is elastic, impervious to water, and unaffected by climatic influences.

It is still general experience that surface wear is concentrated near the rails, in the form of holes and ruts. Macadam paving is used almost exclusively for outlying streets, where the wagon traffic is light, but it is not adapted for those in which the traffic is heavy. For the latter conditions there may be used stone blocks, bricks (exceptionally, in Holland), asphalt, wood blocks, or special methods. The stone blocks should be of large size, dressed on all sides, and the joints well grouted to insure a watertight paving; rapid drainage of the surface water should be provided also. If the rails are shallow there is great difficulty in obtaining a good pavement, as shallow blocks are unsatisfactory; and with deep blocks those next the rails must be dressed to clear the rail base, and may thus lack stability. With shallow rails, therefore, it is advisable to support them on chairs or plates so as to allow of a suitable depth of paving. Fig. 17 shows such an arrangement at Geneva, with chairs on steel ties.

Asphalt is used in city streets on account of its noiselessness; it requires a flatter grade in cross-section, so that special care should be given to the surface drainage. It is considered impossible to maintain a good connection of asphalt against the rails, as the asphalt disintegrates under the influence of their perpetual vibration. A course of poured asphalt composition, or one or two rows of stone or wood blocks may be laid against the rail, the wood blocks being considered the best. Asphalt blocks have been tried for this purpose, but they are not very successful and are expensive. Fig. 17 shows the use of wood blocks at La Haye, and Fig. 18 shows the use of poured asphalt or mastic at Bordeaux (See also Fig. 11-C).

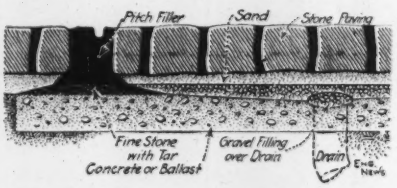

FIG. 20. METHOD OF DRAINING STREET-RAILWAY TRACK AT MANCHESTER, ENGLAND

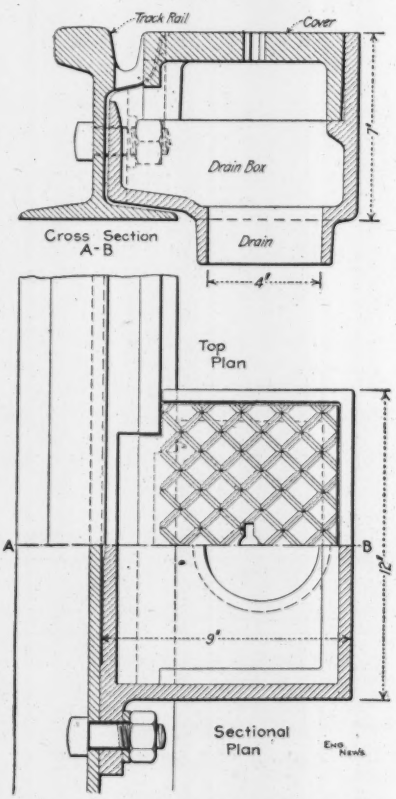

FIG. 21. METHOD OF DRAINING SURFACE WATER FROM TRACK; EAST PARIS TRAMWAYS

For wood paving (as for asphalt) a strong and even base of concrete is required. The blocks must be 4 to 5¼ in. high, and the rail slightly higher (about 6½ in.), so that its base may be embedded in the concrete foundation. Hard wood is only slightly hygroscopic and resists wear, but its wear is irregular and its cost is high. Soft wood is more hygroscopic and wears more rapidly but more evenly. Most lines use hardwood paving blocks. To avoid the pressure due to absorption of water by the blocks, experiments have been made with blocks impregnated with water under pressure. The experiments with these on the East Paris street-railway system were so satisfactory that the blocks are now used on a number of lines on the conduit system, where formerly the swelling of the blocks by the absorption of water exerted such pressure as to reduce the width of the conduit slot. Fig. 19 shows track with wood-block paving, at Geneva, the track having a very heavy concrete base.

DRAINAGE OF THE TRACK

As noted under the heading of "Substructure," one of the principal causes of deterioration of the track structure (with consequent necessity of repaving) is the infiltration of surface water which tends to disintegrate the concrete. It is wise economy, therefore, to provide free and ample drainage of both substructure and superstructure, but more attention is given to the latter as being simpler and cheaper. Drainage of the substructure may be effected by different methods, according to the type of construction. It may be by a continuous bed of gravel (Fig. 11-C), or by drains placed in the center line of the track and connected at intervals with the city sewers. This latter arrangement, as used at Manchester, England, is shown in Fig. 20. The foundation bed of concrete has its upper surface sloped down between the rails to the center, where drain holes are provided at intervals. Upon this bed is a layer of coarse gravel, above which is the sand cushion for the paving. Each rail is laid on a shallow bed of fine stone mixed with tar. At Munich, openings are formed in the concrete base to permit any surface water of infiltration to escape into the underlying bed of gravel. At Chemnitz (with macadam paving) the rails are on shallow concrete stringers on a bed of large broken stone (telford system); under the middle of the street is a stone-filled trench 14 in. deep and 10 in. wide at the bottom, with a tile drain.

Surface drainage of the track is effected usually by means of sumps placed under the groove of the rail at intervals of 100 to 656 ft.; and also at curves, grades, switches, etc. The water falls into the sump through a slot in the rail groove and is carried off by a drain. This rail drain is supplemented sometimes by a narrow transverse drain between the rails, covered with a cast grating, so as

to intercept the surface flow over the paving. Some lines put these drains only at low points and at switches, but experience indicates that this is insufficient and that the sumps should be provided regularly along the track.

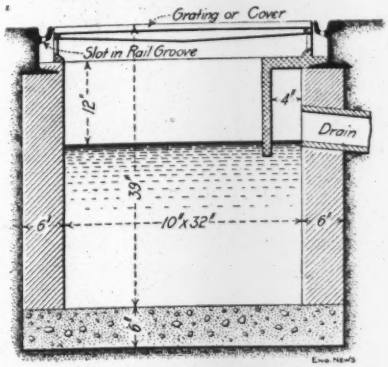

FIG. 22. DRAINAGE WELL FOR SURFACE WATER FROM TRACKS, GENEVA, SWITZERLAND

Figs. 21 to 23 show the drainage arrangements of the East Paris, Geneva and Glasgow lines. In the first two of these the water flowing in the groove of the rail or over the rail falls through a hole in the bottom of the groove. In one case (Fig. 21) it passes to an iron drain box, 9x12 in., bolted against the rail; in the other case (Fig. 22) it passes to a large well or chamber, 10x32 in., 39 in. deep, having a trapped outlet to the drain. The chamber has a rectangular cover, which may be solid, or may be grated or perforated so as to intercept water flowing between the rails. In the third case (Fig. 23) a drainage well is used also, but the outlet is not trapped, and the manhole is much smaller, the manhole frame and its surrounding paving being carried by girders formed of old track rails spanning the well. Instead of using a slotted grooved rail, the track across the well is of special construction; each rail is in two parts, put together with bolts and spacing sleeves, so as to form a drainage inlet which extends the full length of the drainage well.

To prevent the loosening of rails by the softening of concrete beneath them (by surface water entering), Mr. Wattman, of the street railways of Cologne, supports the rails above the concrete base by means of wood blocks, and fills the shallow space beneath the rail with broken stone or gravel. Vertical drain tiles carry off the water to stone-filled pockets in the subgrade (Fig. 24). A modification of this system has small longitudinal conduits or grooves formed in the surface of the concrete along each side of each rail. At the joint and the middle of each rail are vertical tiles extending through the concrete to the subsoil.

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STREET RAILWAY TRACK ON BRIDGES

In many foreign cities and towns there has been complaint of the noise made by cars crossing steel bridges. Various remedies have been tried, but no thoroughly reliable method has been found,

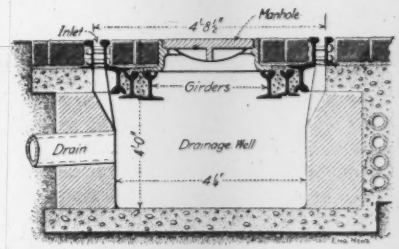


FIG. 23. DRAINAGE WELL FOR SURFACE WATER FROM TRACKS, GLASGOW, SCOTLAND

and the method must depend largely upon the bridge and track construction. In some cases, the conditions hardly admit of remedy, the street-railway engineers not having been consulted in relation to the design of the bridge floor. Many places have tried base plates of felt or fiber, but these wear out in time and the noise again occurs; plates of vulcanized leather have given better results. At Amsterdam, low rails are used and are laid on wood stringers. At Lyons (Fig. 25) there are oak stringers, 9½x16 in., laid on the floor beams and bolted to them; in the stringer is a groove the width of the rail base, and in this is placed a lead plate on which the rail rests. The rails are fastened by screw spikes. Fig. 26 shows a method employed at Dresden. On the Mont Blanc Bridge, at Geneva (with wood-block paving), the rails rest on steel saddles embedded in the concrete base of the floor, as shown in Fig. 19. The concrete is reinforced by longitudinal and transverse steel bars, there being two layers of longitudinal bars at each rail, as shown.

In many cases no special construction is used and the rails are laid directly upon a concrete bed or even upon the steel. A German special 96-lb. shallow rail for tracks on bridges has a height of only 5.32 in., with a base width of 7.12 in.; the width of the head is 3.92 in. (head, 2.04; groove, 1.24; guard, 0.64 in.). This is similar to the rail in Fig. 16.

In Berne, with rails resting on concrete, the noise was reduced slightly by using 1-in. shims of pitch pine, but the cost was excessive in relation to the improvement and the plan was abandoned. Elsewhere ½-in. lead plates were tried, but without effect. The Cathedral Bridge, at Cologne, has the rails bolted to cross-beams, with hardwood blocks fitted between the rails and beam. At Potsdam, the steel buckle-plate floor has a stone filling in which are laid concrete longitudinals having steel reinforcement at the bottom. At Berlin, a similar floor has a concrete filling, upon which is the concrete bed of the track; in this the rails are embedded, with a layer of asphalt under the rail base.

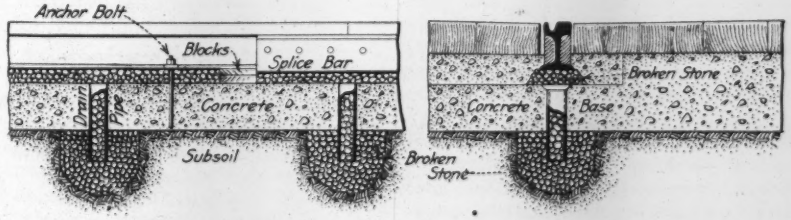


FIG. 24. METHOD OF DRAINING WATER FROM TRACK TO SUBSOIL

SWITCHES AND FROGS

With the development of electric traction and the increase of traffic, engineers and manufacturers have given great attention to the improvement of switches and frogs so as to make them capable of giving good wear under heavy traffic and thus reducing the troubles due to their renewal. Whatever the design, it is important that the several parts should be of exact shape and careful finish and assemblage.

Switches may have single or double rails, the former requiring less cost of maintenance, but the tendency is to use double rails as giving better guidance and greater safety. The former, however (with a fixed rail or mate opposite the switch rail) are quite suitable for such places as terminals, where speed is low. Special care must be given to the trunnion bearing of the switch rail or tongue, both to reduce wear and to provide for adjustment due to wear; in some designs the tongue can be removed for adjustment without disturbing its supports or the rest of the track. Sliding switch rails without pivots are used at Dusseldorf and Munich. At Berlin, the switch rails were curved to 130 ft. radius, but in streets a curve of 50 to 65 ft. is often

Berlin, however, some of the suburban districts have decided that tracks in asphalted streets may be paved with ordinary materials. Four years' experience has shown that this has not only reduced the high cost of track construction in asphalt streets, but has avoided the long interruptions to traffic resulting from the frequent repairs to the asphalt paving along the tracks, and the time necessarily allowed for the new concrete to set. The tracks laid in this way during the four years required no repairs either to the stone paving or to the joint between the stone and asphalt paving.

An objection was made that residents would be annoyed by the noise of street vehicles passing upon or crossing the stone-paved portion of the street; but this has been found to be of very little importance. In fact, when the track is laid with asphalt on concrete, a greater noise is caused by the cars; this is due to the resonance of rails embedded in concrete, especially when the rail wear takes the form of corrugation. Objections as to the bad appearance of two kinds of paving in the street are considered of little importance. If the experiments with bituminous macadam give good results, this material may be employed with advantage; it is cheaper than first-class stone paving, while the passage of vehicles raises no dust and causes no noise. It is possible also that this material may be used instead of cement concrete for the foundation. The experiments are being made with the Aberli macadam, in which coal-tar is poured on the stone, covered with sand, and then mixed. The resultant material is elastic, impervious to water, and unaffected by climatic influences.

It is still general experience that surface wear is concentrated near the rails, in the form of holes and ruts. Macadam paving is used almost exclusively for outlying streets, where the wagon traffic is light, but it is not adapted for those in which the traffic is heavy. For the latter conditions there may be used stone blocks, bricks (exceptionally, in Holland), asphalt, wood blocks, or special methods. The stone blocks should be of large size, dressed on all sides, and the joints well grouted to insure a watertight paving; rapid drainage of the surface water should be provided also. If the rails are shallow there is great difficulty in obtaining a good pavement, as shallow blocks are unsatisfactory; and with deep blocks those next the rails must be dressed to clear the rail base, and may thus lack stability. With shallow rails, therefore, it is advisable to support them on chairs or plates so as to allow of a suitable depth of paving. Fig. 17 shows such an arrangement at Geneva, with chairs on steel ties.

Asphalt is used in city streets on account of its noiselessness; it requires a flatter grade in cross-section, so that special care should be given to the surface drainage. It is considered impossible to maintain a good connection of asphalt against the rails, as the asphalt disintegrates under the influence of their perpetual vibration. A course of poured asphalt composition, or one or two rows of stone or wood blocks may be laid against the rail, the wood blocks being considered the best. Asphalt blocks have been tried for this purpose, but they are not very successful and are expensive. Fig. 17 shows the use of wood blocks at La Haye, and Fig. 18 shows the use of poured asphalt or mastic at Bordeaux (See also Fig. 11-C).

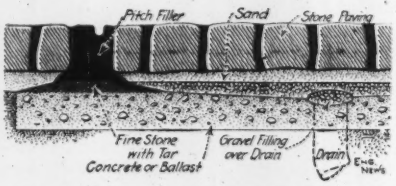


FIG. 20. METHOD OF DRAINING STREET-RAILWAY TRACK AT MANCHESTER, ENGLAND

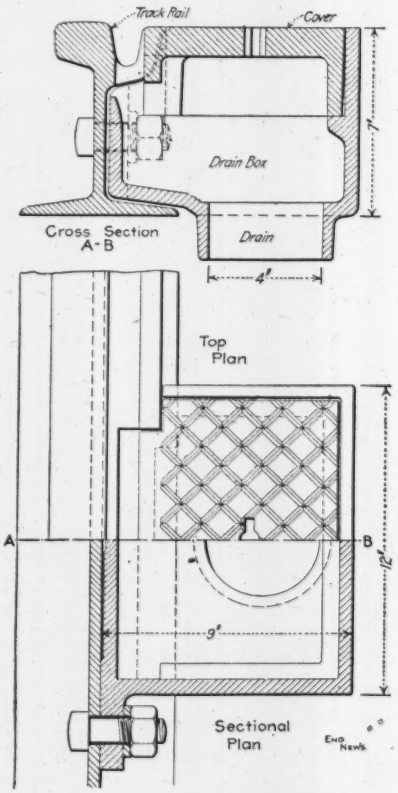


FIG. 21. METHOD OF DRAINING SURFACE WATER FROM TRACK; EAST PARIS TRAMWAYS

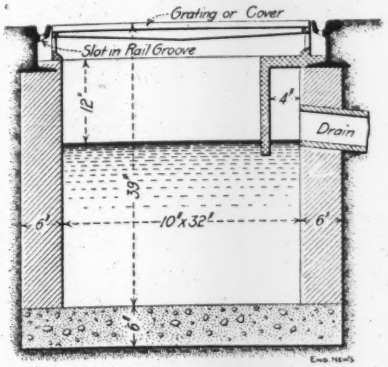
For wood paving (as for asphalt) a strong and even base of concrete is required. The blocks must be 4 to 5¼ in. high, and the rail slightly higher (about 6½ in.), so that its base may be embedded in the concrete foundation. Hard wood is only slightly hygroscopic and resists wear, but its wear is irregular and its cost is high. Soft wood is more hygroscopic and wears more rapidly but more evenly. Most lines use hardwood paving blocks. To avoid the pressure due to absorption of water by the blocks, experiments have been made with blocks impregnated with water under pressure. The experiments with these on the East Paris street-railway system were so satisfactory that the blocks are now used on a number of lines on the conduit system, where formerly the swelling of the blocks by the absorption of water exerted such pressure as to reduce the width of the conduit slot. Fig. 19 shows track with wood-block paving, at Geneva, the track having a very heavy concrete base.

DRAINAGE OF THE TRACK

As noted under the heading of "Substructure," one of the principal causes of deterioration of the track structure (with consequent necessity of repaving) is the infiltration of surface water which tends to disintegrate the concrete. It is wise economy, therefore, to provide free and ample drainage of both substructure and superstructure, but more attention is given to the latter as being simpler and cheaper. Drainage of the substructure may be effected by different methods, according to the type of construction. It may be by a continuous bed of gravel (Fig. 11-C), or by drains placed in the center line of the track and connected at intervals with the city sewers. This latter arrangement, as used at Manchester, England, is shown in Fig. 20. The foundation bed of concrete has its upper surface sloped down between the rails to the center, where drain holes are provided at intervals. Upon this bed is a layer of coarse gravel, above which is the sand cushion for the paving. Each rail is laid on a shallow bed of fine stone mixed with tar. At Munich, openings are formed in the concrete base to permit any surface water of infiltration to escape into the underlying bed of gravel. At Chemnitz (with macadam paving) the rails are on shallow concrete stringers on a bed of large broken stone (telford system); under the middle of the street is a stone-filled trench 14 in. deep and 10 in. wide at the bottom, with a tile drain.

Surface drainage of the track is effected usually by means of sumps placed under the groove of the rail at intervals of 100 to 656 ft.; and also at curves, grades, switches, etc. The water falls into the sump through a slot in the rail groove and is carried off by a drain. This rail drain is supplemented sometimes by a narrow transverse drain between the rails, covered with a cast grating, so as

to intercept the surface flow over the paving. Some lines put these drains only at low points and at switches, but experience indicates that this is insufficient and that the sumps should be provided regularly along the track.



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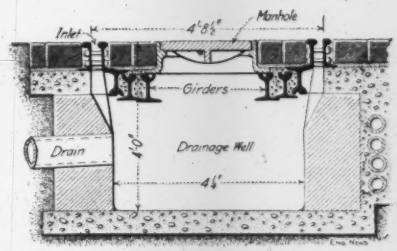

FIG. 23. DRAINAGE WELL FOR SURFACE WATER FROM TRACKS, GLASGOW, SCOTLAND

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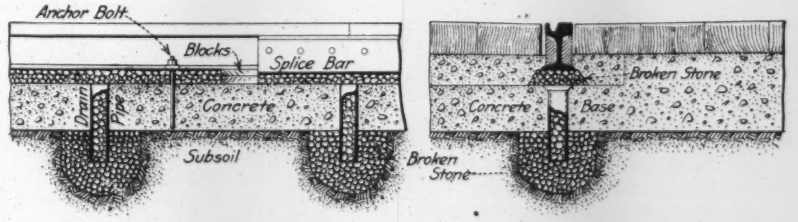

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SWITCHES AND FROGS

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necessary. The connection of these sharp curves with the curve of the switch rail would require parabolic transition curves and a greater length of lead than can be permitted. For this reason the switches are now made of 100 ft. radius, with good results as to wear and as to easy riding of the cars.

The switches are usually constructed of ordinary rails, but until very recent years they did not have the desired rigidity and their cost of renewal was high. The modern switches of cast manganese-steel have fewer parts and much greater resistance to wear. The first cost is much higher, but their economy is greater when the long life and low cost of maintenance are taken into account. No wear in the shape of corrugation has been observed in switches, frogs or curve rails of manganese-steel. Movable-point frogs are not considered desirable by Mr. Rochat, as the parts are necessarily small and are not adapted to stand wear. In frogs made of rails the heads are liable to be crushed and bent down. To prevent this some of the Phoenix frogs have not only a base plate to carry the rails, but also fillers which rest on the rail base and bear against the under side of the rail heads, so that the latter are rigidly supported throughout. Frogs with hard-steel centers are very generally used.

In some foreign cities where a narrowing of the street or the presence of some obstruction prevents the continuation of a double track the two tracks are gantleted to pass the narrow stretch. This is considered preferable to using a piece of single track with switches at each end.*

The handling or operation of the switches requires in many cases an appreciable delay to the cars and presents other inconveniences. Consequently there is a growing tendency to the use of automatic devices put in operation by the car. This practice has the following advantages:† (1) It avoids the use of switchmen, (2) it gives an increase in the commercial speed of the cars, and (3) it effects a saving in current consumed in starting and accelerating a car which has slowed down to pass a switch. These devices may be either mechanical or electrical. In the Samaia mechanical system, two small boxes against the rails (ahead of the switch) inclose levers which operate the switch rails by means of chain connections. On the car is a device operated by the motorman, and permitting a hook to drop so as to engage the lever in the box. In the track, a slot about 2 ft. long is cut in the bottom of the rail groove, and the motorman drops the hook on one or the other side of the track according to the position of the switch.

Several electric devices operate the switch by means of a contact on the trolley wire. With such devices the motorman will still instinctively reduce speed, knowing that the switch rail may be held

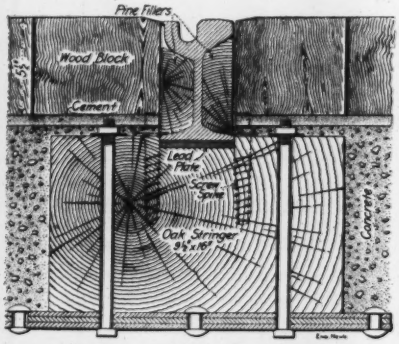


FIG. 25. STREET-RAILWAY TRACK ON BRIDGES; LYONS, FRANCE

open by some obstruction. To prevent this, a set of signal lamps is sometimes installed as an auxiliary device, showing a signal for 3 or 4 seconds as the car approaches. If the right signal is shown the motorman knows that the switch is set in the proper position and that the switch rails are properly home against the stock rails. The Antwerp street railways have 22 switches on this system, each operating about 676 times daily.

SPECIAL EQUIPMENT

The majority of important street railway lines in Europe make use of special machines or equipment in the work of construction and maintenance. Some have concrete mixers (usually operated by gasoline engines), or machines for breaking up concrete by chisels operated by compressed air. The Zurich tramways employ a portable air compressor operating drills, and find the work four times as quick as by hand, while the adjacent asphalt and concrete are not damaged in the same way as when the work is done by hand cutting. For track work there are cold saws (rotary and reciprocating), electric drills and other tools, including several machines for grinding the rail heads in the track. Several lines, however, prefer hand labor as the power machines are costly and must be operated (as a rule), by night, which involves high cost. The Brussels lines find that for sawing and drilling rails hand tools give the best results. The use of bypass tracks to enable repairs and renewals to be carried on is increasing, but many lines prefer to do such work at night when traffic is stopped. A run-around track used in Berlin for tra... repairs in asphalted streets has fl... grooved rails or plates; this track is ... set only 12 or 24 in. from the center ... the permanent track, so that there is ... need of altering the trolley wires. T... plates are 1¾ in. thick, 7 in. wide ... the base and 3½ in. on top, with a rec... angular groove 1¼ in. wide and 1 ... deep.

Another device used at Berlin is a portable electro-pneumatic compressor plant operating four to six compressed-air chisels and hammers. This is used for cutting asphalt paving and concrete foundation for a width sufficient to release the flanges of the rails where joints are to be renewed or low points repaired.

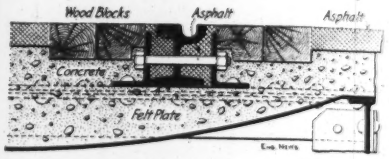


FIG. 26. STREET-RAILWAY TRACK ON BRIDGES; DRESDEN, GERMANY

A muffler reduces the noise to such an extent that there is no objection to the work on the part of residents, even in city streets. The advantage of this method of removing the concrete is that it avoids severe vibration to the surrounding material and to the rails, so that the latter are not loosened from the concrete. A general destruction of the material is avoided also, and the work is so cleanly done that blocks of reinforced concrete may be used to fill the space in the foundation (Fig. 27). Formerly these blocks were secured in position by anchor rods, but in present practice these fastenings have been dispensed with. As the joints between the blocks and the old material are filled with a bituminous grout the track can be put in service as soon as the repair work is done, thus avoiding any delay due to waiting for fresh concrete to set.

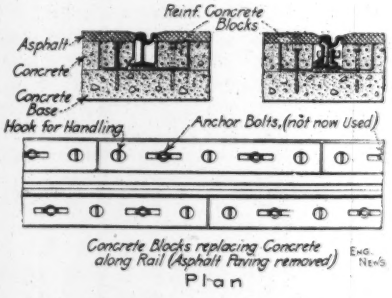


FIG. 27. REINFORCED-CONCRETE BLOCKS USED TO FILL THE SPACE OF CONCRETE CUT AWAY FOR TRACK REPAIRS

*This single-track arrangement is in use in a few places in London; a flagman usually directs the movement of cars over the single track, but sometimes cars in one direction have the right of way.—Ed.

†In London, at many junctions and terminals there are switchmen who operate the switches by levers set in the sidewalk, near the curb line.—Ed.

A Combined Coal Dock Elevator and Crusher*

At the coal dock of the New York Railways Co., 96th St., New York City, the problem had to be met of taking fuel from the barges, crushing, weighing, and delivering to existing conveyors in the monitor of the power house, 138 ft. above the ground. The construction found most desirable has several points of interest. Instead of making a hoist with a lift of 160 ft. or more, it was decided to make the boom of the hoist at a height of 60 ft. and between this elevation and the ground, to put the collecting hopper, crusher, and storage and scale hoppers. The coal, therefore, after leaving the grab bucket, passes through a descent of about 40 ft., in which it is crushed and weighed, and it is then elevated a distance of 120 ft. to an inclined belt conveyor, which delivers it to the existing conveyors in the building. This is shown diagrammatically in Fig. 2.

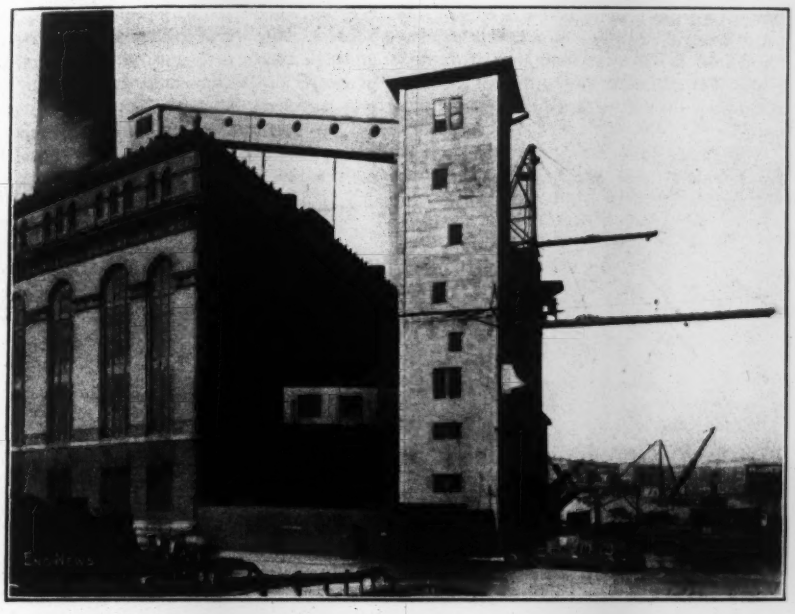


FIG. 1. COMBINED COAL CRUSHER AND ELEVATOR OF THE NEW YORK RAILWAYS CO., NEW YORK CITY

The tower machinery has a handling capacity somewhat larger than the ordinary. Owing to the low lift and to the fact that under that condition the operators have a better control of the bucket, it is possible, with a 1½-yd. clam shell, to handle bituminous coal at a rate exceeding 200 tons per hour.

When bituminous coal is handled, it is passed over a reciprocating feeder to a bar screen. The fine coal passes through this, while the lumps are delivered to a 28x36-in. two-roll crusher having a capacity of 150 tons per hour.

When small anthracite coal is handled, a bypass at the bottom of the collecting hopper delivers the coal direct to the two-way hopper under the crusher. On the floor below this there are two scale hoppers controlled by one operator and from these coal is shot to the elevator. The foot of this machine is placed just below the ground line so that coal can be received from wagons in case of emergency.

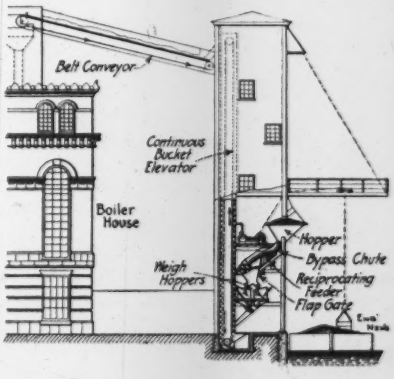


FIG. 2. DIAGRAMMATIC ARRANGEMENT OF MACHINERY IN CRUSHER AND ELEVATOR

The elevator is 122 ft. high, being one of the highest erected. It has buckets 30 in. wide on two heavy steel chains. The buckets travel at 140 ft. per minute and give a handling capacity of 225 tons per hour. All the tower machinery is driven by steam—a 40-hp. engine for the elevator and a 25-hp. for the crusher and feeder.

The chute at the elevator head delivers the fuel to a 30-in. belt conveyor inclined 18° and running at 350 ft. per minute. A 20-hp. motor drives the belt.

The tower shown was designed and built by Post & McCord, of New York City, and the machinery was designed and installed by the Link-Belt Co., of Philadelphia.

*From information furnished by Mr. F. V. Hetzel, Chief Engineer of the Link-Belt Co., Nicetown, Philadelphia, Penn.

How To Get Low Bids from Good Contractors*

BY RICHARD MOREY†

1. Give full and detailed information as to the work, all dimensions, quantities, classes of materials; everything that can possibly be used to figure costs.

2. Ask for bids on as many units as can be applied to the work. This may increase slightly the office work, but it will reduce costs. To use grading as a simple example, a contractor will bid lower and the work will cost the railway company less, if the proposals are made so as to separate bids on excavation hauled, excavation wasted, embankment borrowed, overhaul with a short free haul and all possible classifications of material. To the contractor this means that uncertainties are reduced to one or two items and that he will be paid for just what he does. To the railway company it means an elastic contract that readily covers the inevitable changes of line or plans, and that the company pays for just what it gets.

3. Rewrite some of the clauses in the contracts and specifications, particularly those which applied to former conditions, but do not fully cover present ones, and, especially, some of them which have grown from interlineations made from year to year in your printed forms.

4. Recognize the relation between the responsibility of the contractor and the requirements for the bond and the retained percentage. At the time the contract is signed, and the responsibility of the contractor is measured by the full amount of the contract, the railway company is satisfied with a bond; later, as the work is near completion and parts of it even in use, the railway company still has the bond and also the retained percentage and the contractor's responsibility has become insignificant.

5. Give us as inspectors men whose knowledge of the work at least approaches that of our foremen.

6. Give us our full quantities on our monthly estimates and then see to it that the vouchers made to cover those estimates move promptly through the auditor's office to the treasurer.

*From the "Proceedings of the St. Louis Railway Club."

†Morey-Faulhaber Construction Co., Chemical Building, St. Louis.

High Pressure Gas Distribution at St. Louis, Mo.

By Frank Richards*

Here, in a recent installation of the St. Louis County Gas Co., St. Louis, Mo., is an example of the practical, established transmission of artificial gas at high pressure and its direct delivery to consumers without the intervention of the district gas holder. There are gas holders of the familiar type at the gas-generating plant, where the pressure maintained is from 5 in. to 9 in. of water, the latter being the maximum pressure reached when the tank is full, and no other gas holders are required for the distribution system.

The compressors take the gas at this gas-works pressure and compress it to a maximum of 40 lb. gage. The pipes into which the compressed gas is delivered have a capacity of 20,000 cu.ft., and these constitute the entire storage for the gas after leaving the compressor. As a pressure of 10 lb. is sufficient for all purposes, the permissible range of pressures in this pipe system, about two atmospheres, allows fluctuations in the quantity of gas contained of about 40,000 cubic feet of low-pressure gas, although neither limit of pressure is actually reached in practice. The gas comes to the consumer at whatever may be the pressure in the pipes at the time, and then it passes through an individual pressure reducer, after which it is metered at the constant low pressure maintained.

This is not to be considered as in any respect an experiment, at least with this company, as they have been following this system of distribution for some years, and find that it not only gives satisfaction to all, but that it pays well. They have never experienced any trouble from deposits of any kind in the pipes and the gas is found to be practically as rich after compression and transmission as before. There also has been found no trouble or danger from the heating of the gas in the compressing operation, and there has been no accident of any kind.

In one corner of the compressor room is apparently a vertical receiver, the familiar accompaniment of the air compressor, but in this case it is instead a tar extractor through which the gas passes before entering the compressors. These machines are two duplex gas compressors (Ingersoll-Rand, Class O) with cross-compound steam cylinders 12 in. and 23 in. diameter and duplex tandem gas cylinders 17¼ in. diameter with a common stroke of 18 in. and a normal speed of 120 r.p.m. The gas cylinders are, of course, completely water-jacketed. The mean horsepower is about 120 and the gas compressing capacity, with liberal allowances, about 1,500,000 cu.ft. per 24 hours. This approximates the present producing capacity, but considerably exceeds the consumption.

The compression of the gas under the conditions here presented is a very simple, or as we might say, a very comfortable job for the compressors. The piston inlet furnishes an ideal means for connecting the intake, and the only automatic control required is a speed regulator, as on a stationary engine. This can easily be adjusted for different speeds according to the rate of gas consumption.

The gas is delivered into an 8-in. main, from which there are branches or continuations of 6-in., 4-in., 2-in., and 1½-in. pipes, the aggregate length of which may be inferred from the fact that the area served is about 120 sq.miles. The present number of customers is 6000, which number is being increased as fast as the pipes can be laid, the present daily output of gas being approximately 500,000 cu.ft. Only one of the two compressors is as yet required, and this is run 16 hours a day.

The illustration herewith shows a 24-hour record from the recording pressure gage, located near the beginning of the 8-in. pipe line. This record reads from 8 a.m., Nov. 25, to 8 a.m., Nov. 26, 1911. The record line coincides almost exactly with that of another gage 2¼ miles away, thus assuring us how little loss of pressure there is in this transmission over two miles, and suggesting that the same pipe may easily transmit twice or three times the present volume of gas.

The record line of the pressure-gage chart tells its story very clearly. The record begins a little after 8 a.m., and at 9 a.m. everything is running smoothly, the output of the compressor evidently keeping pace very closely with the eight mid-day hours to 5 p.m., a slight loss of pressure appearing about noon, when we may assume that some extra gas is used for cooking purposes. At 5 p.m. the demand for both lighting and cooking causes the pressure to fall quite rapidly for the next two hours. This is when the "peak" load occurs, the peak being represented on the diagram by a depression.

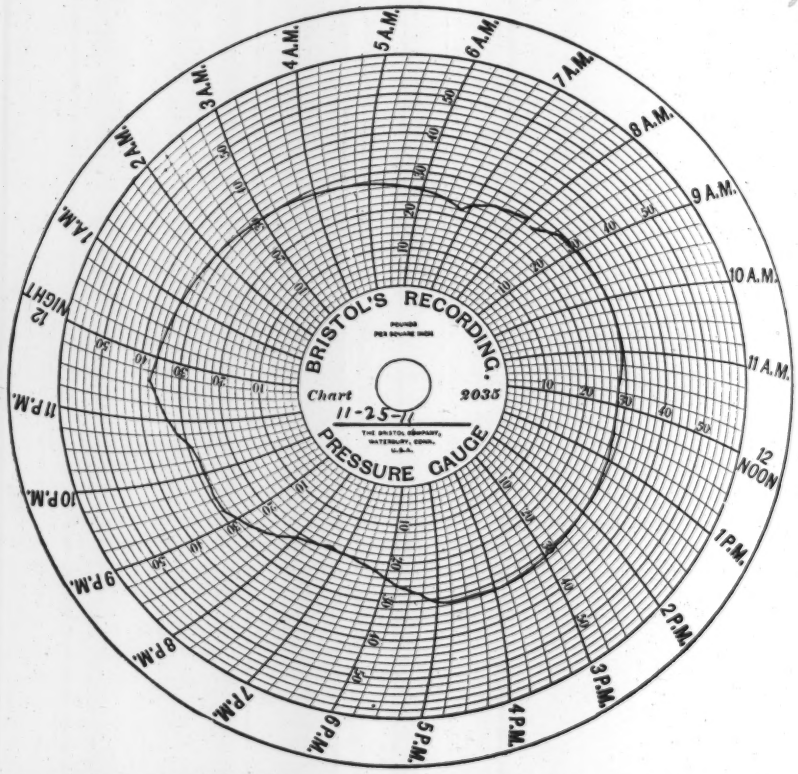


Chart Record of Gage Pressures in an 8-in. Gas Main at St. Louis, Mo.
(High pressure distribution system.)

Before 7:30 p.m. the compressor output has caught up with the consumption. Then the pressure rises gradually until 9:15 and is nearly stationary until 10:15, when there is a rapid rise until 11:30. The upper working limit is nearly reached here and the compressor is stopped, as indicated by the sharp angle at 11:35. From this point until 6:50 a.m. the compressed gas in the pipes is sufficient to supply the demand. The drop is very rapid after 6 a.m., but after the compressor is started the line rises easily before 9 a.m. to the normal day working pres-

*229 West 135th St., New York.

sure of about 30 lb. The pressure where the record ends at 8 a.m. seems to be about 2 lb. higher than on the preceding day; perfect coincidence, of course, was not to be expected.

The system of high-pressure gas distribution is constantly extending, both in this country and in Europe, and entirely upon a business basis. It is found that the cost for installation, operation and maintenance of compressor and high-pressure piping is less than that of the much larger low-pressure pipes, the district gas holders and the land actually required, to say nothing of the depreciated land values which the community has to stand in the vicinity of gas holders.

The plant here spoken of is a comparatively small one. That the principle it embodies is practically applicable to much larger service is self-evident. That it is not applicable and that it will not eventually be applied to all gas service, however vast or concentrated, I am not asserting.

A Municipal View of Fire Protection Methods*

By Carter H. Harrison†

A comparison is frequently made between Chicago and Berlin in the matter of losses by fire. The population of the two cities being approximately the same, it is shown that the fire loss per capita in Berlin is only 10% that of Chicago, and the cost of maintaining fire departments is in about the same ratio. Speakers and writers on this subject call attention to the carelessness of the American people as compared with the greater regard for the property rights of one's neighbor evidenced in the practices and the laws of the German capital.

I believe it is the duty of a municipality to protect the lives and property of its citizens against loss by fire, and that this protection is quite as essential as proper protection against contagious diseases and similar menaces to the public health. Fire departments are maintained for this purpose, building laws and ordinances are enacted, fire limits are prescribed, and in Chicago at the present time we have in contemplation the establishment of a special Bureau of Fire Prevention to deal with many phases of this subject, which do not or cannot come within the scope of the duties of present municipal officers.

At the same time I wish to point out what I believe to be the underlying cause for the disproportionate losses by fire in American cities. No one has a greater admiration than I have for the thrift of the German people or the orderliness of German municipalities, but we must not lose sight of the fact that the average European city was not built in 75 years. Chicago, which has grown to its present size in this comparatively short period, could not possibly have attained its present size and importance as a city if it from the outset had attempted to follow those precautions which we at the present time recognize as necessary.

It is indeed a heavy tax that we pay for rebuilding our cities through loss by fire, and it is to be hoped that modern building construction and methods are sufficiently stable so that future improvements will take place through other agencies. As a means to this end, it should be the aim of every municipal officer to increase the efficiency of his city's fire defense. The separate high-pressure fire service system of water supply has been adopted more or less completely by a number of cities, and in Chicago we are endeavoring to put this movement forward in connection with our subway and other problems of underground construction. We have a new, and what we believe to be a comprehensive, Building Code, in a proper enforcement of which we are determined to proceed. The enforcement of adequate building regulations and the equipment of premises with first-aid appliances is essential in connection with all large establishments, and particularly in those places where large numbers of people congregate.

*From an address delivered at the annual meeting of the National Fire Protection Association, held at Chicago, May 14 to 16, 1912.

†Mayor of Chicago.

Fire Waste and the National Fire Protection Association*

By W. H. Merrill†

The need for the work of the National Fire Protection Association is emphasized today as never before. The fire waste, in opposition to which we are organized and working, is growing more rapidly than the defense. The year 1911 shows a larger sacrifice of life and property in America through loss by fire than any previous year not visited by a great disaster or a general conflagration. And the year 1912 bids fair to equal or surpass its predecessor. Hence the necessity for a constantly increasing activity and an enlargement in the extent and scope of our work, and the need for saving the lives lost through carelessness and the millions in property values wiped out through preventable causes.

Years of unceasing, intelligent, organized effort will be necessary to overcome the accumulated mistakes of years. And age alone may serve to sober the impetuosity and carelessness of youthful America, which builds for today, is too often selfish in its regard for the present, and much too heedless of necessary safeguards for the future. Age brings experience and experience is the greatest of teachers. Civilization has advanced through bringing home to the individual the experience of the many, which is education. And education, according to modern tenets, is best imparted through adding the practical to the theoretical, by accompanying the lecture and the textbook with the demonstration.

Surely there is no lack of the latter, for as Mr. Wentworth has said, "pillars of smoke by day and scarlet heavens at night" are everywhere about us. The pity is that so few view them in their true significance. After enjoying the spectacle of our neighbor's house in flames, we give him shelter for the night and dismiss the economic aspect of the case with inquiries as to the extent of his insurance. In older countries they put him in jail if negligence is shown, and look with suspicion on enthusiastic bystanders as possible accessories to the crime of robbing the common purse.

That every wage earner contributes to replace value which is destroyed, whether it be a city or an ocean liner or any other loss, is plainly manifest, for the cost of insurance is an item in everythng represented by dollars and cents. San Francisco, Baltimore, the "Titanic," and all the lesser catastrophes are paid for not by the insurance companies nor by the men who pay for one or another kind of insurance, but ultimately by the man who pays for a loaf of bread or a suit of clothes or any necessity or luxury of life. The cost of living is in proportion to the cost of replacing values destroyed. And the cost of the fire waste, like so many other evil things, falls upon that long-suffering individual "the ultimate consumer."

All this and much more has been said many times and in many places, but we must continue to reiterate the fundamentals of our doctrine whenever and wherever opportunity affords, for by such means will its truth spread and be accepted. And it is well that in calling attention to the fault we also suggest the remedy, for criticism which is not constructive plays but a small part in rendering complete and effectual service.

In our 16 years of endeavor we have covered a field so comprehensive that we are far in advance of the possibility of censure on this score. Our literature, our records and our actions embrace a consideration of everything from the large subject of conflagration conditions to the small item of the number of threads per inch on screws for electrical fittings. Throughout laws and ordinances, rules and requirements, specifications and standards utilized by all interests in all sections will be found the recommendations of this Association.

*Abstract of the presidential address at the annual meeting of the National Fire Protection Association, held at Chicago, May 14 to 16, 1912.

†207 E. Ohio St., Chicago.

The Welin Davit for Launching Lifeboats*

By Axel Welin†

A question of importance frequently asked at the present time is whether it is possible to provide passenger-carrying steamers with sufficient boat accommodation for everybody on board. To this it might be replied: "Do not allow more people to get on board than the lifeboats will carry, and you have boat accommodation for all." The rigid enforcement of such a rule, however, would in numerous cases create a tendency to stack boats on top of each other, and probably in such a way as to effectually prevent their being kept in a seaworthy condition, or to impede their efficient and expeditious handling.

boat of that size, and a great many people now complain that this number is much in excess of what it ought to be. Possibly it is. In rough weather such a load would certainly be dangerously heavy. The official rules call for 10 cu.ft. of space for each person carried. Supposing this were to be increased to 15 cu.ft., what would be the result? A ship certified to carry 3500 would, with the present allowance require 54 lifeboats, each with a capacity of 650 cu.ft.; in the second case this number would have to be increased to 81.

Three boats of the size above mentioned, chocked in the usual way, would require 1000 sq.ft. of deck space in order to be properly stowed, and allowing space for their efficient handling. That is to say, the surface area required for the 81 boats referred to would amount

or badly listed, to perform boat drill or maneuvers; and it is, therefore, an unhappy fact that the majority of boats are very rarely tried under the actual conditions in which they might at any moment be required in an emergency.

In the Welin system, the chief mechanical gain is due to the fact that in rolling the quadrant outboard by means of the operating screw, the fulcrum itself moves outboard simultaneously. (See Fig. 1.) The arrangement of bringing back the falls over the sheaves on the stationary davit frames before belaying is also an important factor, materially easing the boats off their chocks when swinging out, and allowing a slight corresponding drop when the boat is being brought inboard. A feature of great practical value which must not be overlooked is that the davit arms are always

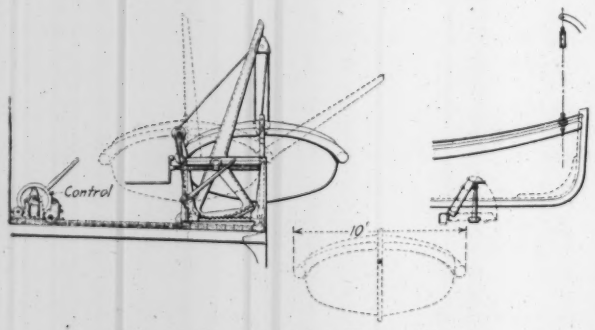


Fig. 1. Single-acting Welin Davit

(Showing special hoisting and lowering apparatus as installed on the Hamburg-American liner "Imperator," now under construction.)

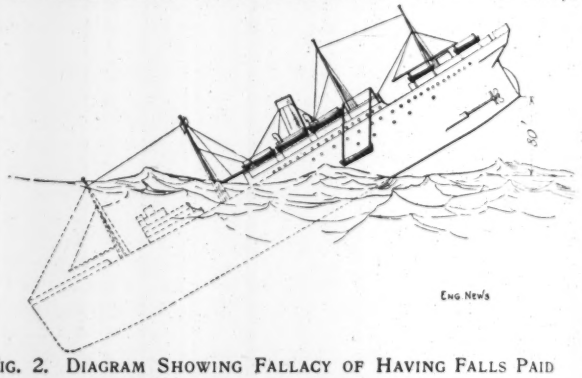


Fig. 2. Diagram Showing Fallacy of Having Falls Paid Out Automatically in Equal Lengths

(The steamship "Pericles," which sank two years ago, remained in the position shown for 25 minutes.)

It stands to reason that a boat deck originally planned for, say, 12 lifeboats, may—and probably will—be quite unsuited to carry 36. I have in mind just now two beautiful Atlantic steamers under construction on the Clyde, each destined to carry 2100 souls. With the present arrangement of the superstructure, the available deck space is just a foot or two too narrow for double-banking the boats. By reducing the width of the deckhouses a few feet, sufficient space might, however, be obtained; and if done, ideal conditions for the installation of twice the number of boats would be the result. What I think may safely be said, is that the plans of any ocean steamer with three open decks might, without great difficulty—and also without detracting materially from the comforts of the passengers—be so arranged as to provide sufficient boat accommodation for every soul on board.

Now it may be asked, what is "sufficient boat accommodation"? A lifeboat 30 ft. x 9 ft. x 4 ft. will keep afloat with 100 people on board—that is, if the sea is smooth. The rules only allow 65 in a

to 27,000 sq.ft. Taking all this into consideration I feel we must be satisfied with the existing rules, so far as the actual accommodation of passengers in the boats is concerned.

I have frequently been asked to explain the reasons for the success of the Welin system and the only reply I can give is that, in spite of its extreme simplicity, this davit does meet the majority of the difficulties. It is positive in its action, and, provided the list is not too great to obtain any sort of footing on deck, will swing a boat off the high side of the ship almost as easily as from the lower side. My aim has never been to obtain a "lightning speed" contrivance, but one which might, as far as possible, be depended upon under all circumstances.

Let it be clearly understood, however, that I do not attempt to deny that very smart and good work has been done with the old round-bar davits, and, where the boats are kept in proper order and the crew well drilled, it is quite possible—under favorable conditions—to make a very good showing at boat drill or times of survey. It goes without saying, however, that it is not usual to select a really rough day with the vessel rolling heavily

under control and may safely be left to themselves at any point in their travel. Thus the outreach can, within reasonable limits, be adjusted to suit any position the vessel may assume.

Special Lowering Devices

Exigencies of constructive design have naturally compelled the manufacture of many modifications, yet it has been an invariable rule that the original simplicity should be maintained as far as possible. Only in cases of exceptional pressure from the ship owners has this rule ever been waived. An example of this occurred with the American lake boat "Alabama," in which the davits were fitted with a special lowering device. The idea was to prevent the one fall running out more quickly than the other. In view, however, of the ever-varying conditions at sea, any mechanical contrivance which precludes the intelligent handling of the boats must, in my opinion, be regarded as dangerous and fundamentally wrong in principle.

The following instance, though of an extreme nature, may serve to bear out this statement: The S.S. "Pericles," belonging to the Aberdeen Line, sank the year before last, about six miles south of

*Abstract of a paper read May 9 at a meeting conducted by the American Museum of Safety in New York.

†5 Lloyds Ave., London, England.

the coast of Western Australia, after having ripped her hull on an uncharted rock. She did not immediately go to the bottom, but settled by the head, until at last she assumed the position shown in Fig. 2, and remained afloat thus for some 25 minutes. If it had been possible to pay out the falls in equal lengths only it will readily be seen that this would have prevented the launching of the boats and a catastrophe would have been unavoidable.

The question of special lowering and hoisting apparatus naturally assumes a very different importance in ships of such dimensions as, for instance, the Hamburg-American S.S. "Imperator"—now under construction—where the height of the boat deck above the water is equal to the height of a six- or seven-story dwelling house. In this case, however, the problem found solution on quite different lines. The davits—of the Welin type—are fitted as nearly as possible in their usual simple form, but the boats are hoisted by means of a "control" (Fig. 1) which, when required, is thrown into gear with an electrically driven fore and aft transmission shaft, which may serve any number of boats.

Flexible steel-wire falls are used and are run through shallow channels across the deck from the davits to the control. Requisite provision is made for any correction in the length of falls, so that the launching can be carried out with the boats at any angle that the conditions may necessitate. The launching maneuver—which can be carried out in from 40 to 50 seconds—is entirely accomplished by hand, and the power-transmission shaft is, of course, only required for hoisting. The power absorbed in hoisting the boats at an approximate speed of 1 ft. per second is 10 hp. per boat.

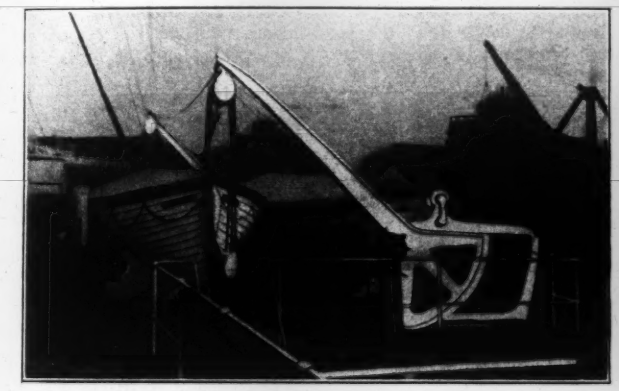


FIG. 3. DOUBLE-ACTING WELIN DAVIT OF THE TYPE FITTED ON THE "TITANIC"

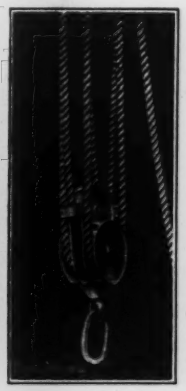


FIG. 4. NON-TOPPLING BLOCK FOR LIFEBOAT TACKLE

DOUBLE-ACTING DAVITS

Perhaps the most notable of recent modifications of my system is the one illustrated by Fig. 3—the so called double-acting type of davit—which was actually fitted throughout on the "Titanic." On the basis of this design the Board of Trade drafted a new rule by which a certain proportion of the boats may be carried double banked, i.e., one inside the other, and still be counted as standing "under davits." This type of davit, whether fitted in conjunction with the controls just referred to, or provided with ordinary manila falls, may prove to be the salvation of the present situation when the necessity for increased boat capacity has been so strongly brought out. It is a perfectly simple thing to get the first boat out, lower it, swing the davit back, pick up the second boat (by which time the first one will have got clear of the ship's side), and repeat the proceeding where there is a third boat.

One point which worried me a great deal after this davit had been designed, was the difficulty with the tackle. Because, after the first boat has been lowered it will be obvious that the tackle must be pulled up, or "overhauled," so as to pick up the next boat. If blocks of the ordinary type were used, the bottom block would be almost sure to turn over, or foul, causing loss of valuable time, or perhaps rendering the whole thing unworkable. Or else a spare set of tackle must be carried for the inboard boats and hooked onto the davit heads, thus involving further loss of time. These troubles were finally overcome by means of a non-toppling block, specially designed for the purpose (Fig. 4). Exhaustive experiments have been carried out, and it has just been adopted on a wholesale scale by some of the largest shipping companies in Europe.

STOWING THE BOATS

There are two points in connection with the question of stowing boats which—in my opinion—ought to be strictly observed. First, that they should be within actual reach of the davits by which they are to be handled: and secondly that they should, as far as possible, be out of danger in case of collision or bad weather. In order to gain deck space for the greater comfort of the passengers, it is the practice in many ships to swing the boats out on leaving harbor, and to let them hang thus from the davits absolutely unprotected. It has been argued that, in case of stranding, the boats would thus be more readily got into the water, but the much greater danger of getting them smashed into splinters were a collision to take place, is completely ignored. No consideration of comfort should, I think, be allowed to influence a question of this nature. With efficient gear for lifting the boats outboard, these might be kept in a protected position and still be ready for immediate use. A high degree of reliability is in these matters of far greater importance than the possible saving of a few seconds.

A way of stowing boats, which I have sometimes heard described as an ideal one, is that in which they are placed five or six abreast clear across the deck, with a pair of davits at each end of the row. On account of unavoidable deck obstructions, however, it is difficult to arrange on a large scale and is, moreover, open to certain objections. The gravest of these is perhaps that an accident, the impact of a collision, for instance, may prevent the launching of the outside boat. With only a moderate list of the ship it would be practically impossible to run the remaining boats up the incline and the whole of these would thus, in one stroke, be thrown out of action. It seems advisable, therefore, to limit the units under each set of davits as far as possible, and to spread the installation along the whole length of the deck. In my opinion the maximum number of boats to be handled by one set of davits should not exceed three.*

There is an old and very generally accepted maxim that lifeboats cannot be properly handled if, in case of an accident, passengers are allowed on the boat deck, and that, therefore, the boats have to be lowered to the deck below before being manned. With the old-fashioned gear I dare say this is the proper course to follow, but I wish to make it quite clear that it is neither necessary nor desirable where the boats are slung from davits of the quadrant type.* With these the right way of loading undoubtedly is to swing the boats just free of the chocks and no more; the people are then allowed to enter while the boat is still partly inside the edge of the deck and then, when

*As a feasible arrangement of such a unit, Mr. Welin suggested a double-acting davit with one regular lifeboat next the rail and two collapsible boats inboard, one on top of the other.—Ed.

everything is ready, swung fully outboard, clear of the ship's side and subsequently lowered.

In concluding my remarks on this comprehensive subject, I wish to say that we have already received from a large number of ship-owners on both sides of the Atlantic conclusive proof, not only of their readiness to accept without demur any reasonable legislation that may be decided upon, but that they are even anxious to anticipate any demands for further safety measures. Boat decks are being planned with a view to carrying a full complement of lifeboats, and the matter of expense has in many cases already become a minor consideration. It is now not a question of saving money but human life.

The Boiling and Steam Tests of Cement

By William P. Gano*

It is generally stated, in the various books on cement and concrete, that pats made of so called unsound cement will disintegrate when placed in boiling water or over steam, no matter how long after the pats are made up the boiling may take place; or in other words, if two pats are made up of a sample of cement which fails on the boiling test and one is boiled at the end of 24 hours, and the other at the end of a year, both will fail. It has long been known that *cement* will season sound when exposed to the air, but it has never been known, at least, to the writer's knowledge, that *concrete* will season sound. That it will do this the following experiments will show:

A sample of portland cement, failing to stand the steam and boiling test, was made into 15 pats. At the end of 24 hours these pats were taken from the moist closet and one of them boiled in the usual manner and found to be decidedly unsound. The remaining 14 pats were divided up as follows:

	Air	Water
7 days	1	1
28 days	1	1
2 months	1	1
3 "	1	1
6 "	1	1
1 year	1	1
2 years	1	1

*Chief Chemist of the Pennsylvania Cement Co., Bath, Penn.

TABLE I

Chemical Analysis

	Per cent.
Silica	21.24
Iron and alumina	10.58
Lime	61.90
Magnesium Oxide	3.14
SO_3	1.51
Loss	1.05
Ratio	1.94

Tensile Strength

	Neat	1 to 3 sand
24 hours	380 lb.	...
7 days	620 lb.	272 lb.
28 days	700 lb.	325 lb.
3 months	670 lb.	400 lb.

Setting time, 76° F., using 23% water
Initial, 3 hrs. Final, 5 hrs.
Specific gravity, 3.15.
Soundness, boiling test, bad.

Fineness

	Per cent.
100 mesh	96
200 "	76
50 "	99.9

and, at the end of each of the above periods, the air and water pats were boiled in the usual way. The analysis and tests of the cement selected were as shown in Table I.

The cement was very carefully mixed and all pats and briquettes made the same day, so that the cement had no chance to season out before being made up into the pats.

After the pats were set hard, the one set marked "Water" was placed in a briquette tank and left there until the time came to have them boiled. The pats marked "Air" were placed on the shelf where car samples are kept and left there until the time came to boil them.

Both the air and water pats were boiled according to the Standard Specifications, at the end of the time indicated above.

The results of the boiling test made upon the various pats is indicated in Table II, while the accompanying figures show the state of the pats after the test. Fig. 1 shows the one-day tests, Fig. 2 those that were damaged and Fig. 3 those that remained sound. The letters on the figures correspond to those in the first column in Table II.

It will be noted that, after seven days, both air and water pats were still unsound, but the 28-day pats, after being boiled, showed signs of seasoning. At the end of two months, the water pat was perfectly sound, while the air pat had a slight crack. At the end of three months, however, both air and water pats proved to be absolutely sound, as did the six-months, one-year and two-year pats. Figs. 1-3 show all of these pats.

A number of sand and neat briquettes of the same cement were also made and it was found that the sand ones boil with much less seasoning than the neat ones. This is no doubt due to the porosity of the sand briquettes; and, as cement is seldom, if ever, used neat, and concrete being porous, it would, in consequence, season out very quickly.

We have also tried boiling all our six-months and one-year briquettes, both neat and sand, and have not found one to fail, even where the cement itself, from which these briquettes were made, failed to boil.

We will all agree that when something goes wrong on a work, the cement is usually blamed. Often, however, the chemist or someone from the mill goes to the job and investigates and finds that they have been using poor sand or cutting down on the cement, or have done some other thing which is not in accordance with specifications. As far as the writer knows, no one has ever been able to point to a single instance where a failure of concrete could be definitely proved to be due to unsound cement.

It would, therefore, appear to me that concrete made from an unsound cement, properly worked, would, at the end of three months, be as good as if the cement were sound in the beginning. This being true, the boiling test then is of little value as a guide to the quality of cement.

Fig. 1. One-day Tests

Fig. 2. Unsound Pieces

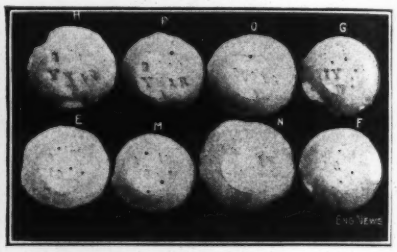


Fig. 3. Sound Pieces

Figs. 1-3. Test Pieces After Boiling Tests

TABLE II

WATER PATS

	Description	In water	Same pats boiled as per standard specifications
A	1 day	O.K.	Badly disintegrated
B	7 days	O.K.	Badly disintegrated
C	28 days	O.K.	Radial cracks
D	2 months	O.K.	O.K.
E	3 months	O.K.	O.K.
F	6 months	O.K.	O.K.
G	1 year	O.K.	O.K.
H	2 years	O.K.	O.K.

AIR PATS

		In air	Same pats boiled as per standard specifications
I	1 day	O.K.	Badly disintegrated
J	7 days	O.K.	Badly disintegrated
K	28 days	O.K.	Radial cracks and checked
L	2 months	O.K.	One radial crack
M	3 months	O.K.	O.K.
N	6 months	O.K.	O.K.
O	1 year	O.K.	O.K.
P	2 years	O.K.	O.K.

Another Venturi-Tube Dosing Apparatus for Water Supplies

An apparatus for introducing a chemical reagent into water flowing through a pipe under pressure was described in ENGINEERING NEWS, May 25, 1911. The difference in pressure in the mouth and throat of a Venturi tube introduced into the pipe line was made to control the rate of feed of the reagent. Thus the reagent was supplied in a fixed proportion regardless of variation in the flow through the main. Another device operating on the same principle differently applied is described in a recent issue of *The Engineer* (Mar. 29, 1912).

In this device, shown diagrammatically in the figure herewith, the pressures in the mouth and throat of the Venturi tube connecting the cylinders to the balance beam are so proportioned that with the cylinders at the same height the feed tank, which is attached to the balance beam, will be in such a position that the level of the solution in the feed tank will be just below the discharge nozzle. The level of the solution in the feed tank is kept constant by a float valve. The position of the tank can be adjusted by means of the turnbuckle in the rod at the right end of the beam in the figure.

When the water is started flowing through the main, the water level in both tanks will fall, say to the levels H_2 in the figure, with the level in the left-hand tank, connected to the mouth of the Venturi tube, higher than that in the right-hand tank, connected to the throat of the tube. As a result, the equilibrium of the cylinders and balance beam will

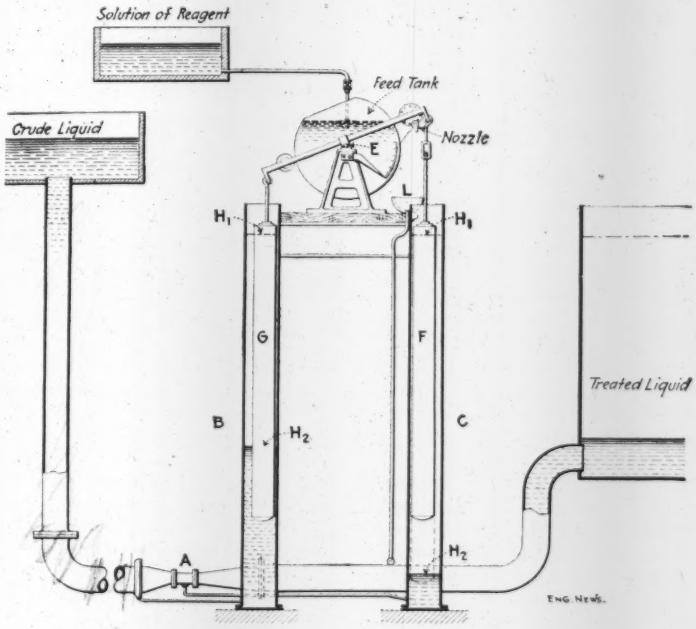


DIAGRAM OF THE TILTOMETER DOSING APPARATUS

at *A* are communicated to the two vertical tanks *B* and *C* respectively, so that the height of liquid in these two tanks varies with the Venturi pressures. In these tanks are suspended the hollow cast-iron cylinders *G* and *F*, hung from hooks in the end of the balance beam with fulcrum at *E*. These cylinders are so proportioned that their specific gravity is somewhat greater than unity, so that they are submerged in the liquid in the tank.

With no water flowing through the main the pressure at the mouth and throat of the Venturi tube is the same and consequently the liquid in the two tanks *B* and *C* stands at the same height, say at H_1 in the figure. Under these conditions the cylinders *G* and *F* will hang at the same height. The lengths of the rods be disturbed and the right-hand cylinder *F* will descend sufficiently to equalize the immersion of the two cylinders. This motion of the cylinders causes the balance beam and consequently the feed tank to be tipped down at the right, so that some of the solution in the tank flows out through the nozzle into the cup *L* and then through the feed pipe into the main.

The amount by which the feed tank is tipped and consequently the head producing the flow of solution through the feed nozzle is proportional to the movement of the cylinders *G* and *F* and therefore to the difference in head at the mouth and throat of the Venturi tube. Hence the quantity of solution added is at all times proportional approximately to the amount of water passing through the main. The orifice of the feed nozzle can be adjusted to give the desired number of grains of solution per gallon of water treated.

It is claimed by the manufacturer, George Kent, Ltd., of High Holborn, W. C., London, England, that the variation in the proportion of solution added does not exceed 1¾% from the mean under the most extreme conditions of working. In support of this claim, the following results are given of tests made upon one of these devices:

Water	Solution, gals. per hr.	Per cent.
640	19.8	3.09
1720	52.2	3.04
1820	57.2	3.14
2390	73.7	3.08

The device has been patented jointly by the Hon. R. C. Parsons and Mr. Walter G. Kent. It is manufactured under the trade name of "tiltometer."

Railway Employees, and Not Railway stockholders, benefited by the increased earnings of railway companies in 1911. Statistics collated by the Bureau of Railway Economics from the reports to the Interstate Commerce Commission show that the total amount paid to railway employees during the year ending June 30, 1911, was in round numbers $50,000,000 greater than in the year previous. Of this $50,000,000, $27,500,000 was provided by an increase in the railways' gross earnings and $22,500,000 came out of railway profits, or in other words, was deducted from the amount available to pay dividends to stockholders. That this increase in wages was due to an increase in the average amount paid per man and not to an increase in the number employed, is shown by the fact that there were 31,000 fewer railway employees in 1911 than in 1910.

NEWS NOTES

The Death Rate among Native Laborers in the mines of Southern Rhodesia is given in the report of the Executive Committee of the Rhodesia Chamber of Mines for the year ended Dec. 31, 1911, as 32.6 per one thousand per annum. The death rate from disease was 28.76, and that from accidents 3.84 per one thousand per annum. The mortality from pneumonia is given as 17.3 per one thousand per year as compared with 27.5 per one thousand in 1910. These rates are calculated on the daily average number of natives employed for the first 11 months of 1911, returns for December being not yet available. The average number of native laborers employed in the mine during this period was about 38,600, of whom all but about 1300 were employed in gold mines. Comparative figures of the death rates for the past three years are given as follows:

	1909	1910	1911
From diseases:			
Deaths	1,383	1,682	1,012
Deaths per 1000 per annum..	42.27	44.46	28.76
From accidents:			
Deaths	161	182	144
Deaths per 1000 per annum..	4.92	4.81	3.84
Total deaths per 1000 per annum	47.19	49.27	32.60

The death rate from accidents is a trifle higher than that for coal mines in the United States. For comparison it may be noted that the total death rate from all causes in New York City for the 12 months ended Sept. 30, 1911, was 12.9 per 1000.

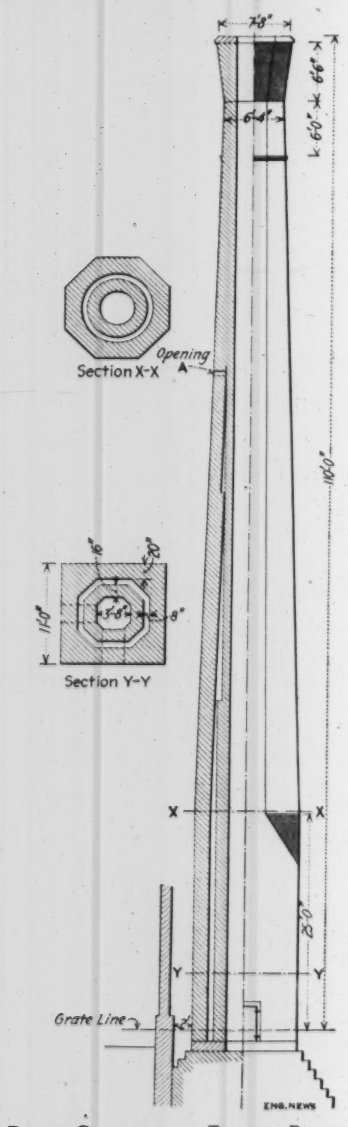
FIELD AND OFFICE

Peculiar Cracking of a Brick Chimney, and Its Repair

By J. Walter Ackerman*

The accompanying illustration shows a brick stack at one of the pumping stations of the water-works of Auburn, N. Y. At the time the stack was built it happened, as is very often the case, that the city was short of funds. In order to secure the necessary throat area of the stack the inner wall of the stack was built separate for about two-thirds the distance, and then, as may be seen, it was joined, and one wall continued to the top. This, of course, cut down the expense of building, and as there were quite a number of stacks in the city built along similar lines, although none of quite this height, it was decided to build according to this plan.

*Chief Engineer and Superintendent, Water Works, Auburn, N. Y.



Brick Chimney of Faulty Design Which Cracked at "A"

The stack was erected in 1904; it was built by a contractor who has a reputation for doing extra good work. The work on our stack was done by the day, on a percentage basis, rather than by contract, so that there was no incentive whatever to in any way slight the work.

A short time after the writer assumed control of the water department, in September, 1908, he discovered that there was a narrow white ring showing entirely around the chimney. From all observations I could make at the time it looked like an efflorescence, and seemed to gradually disappear. But later in the winter a number of bricks fell out. An examination by a transit glass, from an elevation on an opposite hill, showed that there were a number of bricks out, and there appeared to be a crack around the outside of the chimney. I then had a scaffolding built up to the place, and discovered that the outer wall of the chimney at the point marked *A* was open all the way around about ¼ in., that several bricks had fallen out, and that the entire top of the chimney above the point *A* was carried on the inner wall. As there was some space between the outer and inner wall, the flexure of the core wall and the superimposed top, caused by the wind, would make the upper portion vibrate around the lower portion, so that there was at least an inch projection of the upper outer wall over that of the lower as it vibrated back and forth. This was very disconcerting to an observer, as I can testify, when I stood on the scaffold, about 60 ft. above the ground, and watched it.

Apparently the lining wall had expanded and raised the entire top so that the outer wall had simply separated just below the point where the two walls came together. I had the outer wall repaired where the bricks had fallen out. Then, taking an old saw of almost the same thickness as the crack in the outer wall and carefully cleaning out all the mortar between the bricks, I had a large number of steel wedges and shims made, the wedges and shims being of varying thicknesses, and the wedges having a very slight taper. I then waited for the weather to get somewhat cold, when we forced our boiler furnaces for a day, so that the inner wall would get as hot as possible, and I inserted the wedges in this crack, one to every brick, and then with an experienced man carefully drove them in, a blow on each, following around the stack until they were driven way in out of sight, raising the entire top above this point about ¼ in., thereby transferring the load to the outer wall. The remaining space was then carefully filled and tamped with a rich cement, and the whole was left until spring, scaffold and all. The next spring I examined the job and found that there was not even a hair crack showing at this mortar joint. It has shown no signs of trouble since that time.

Use of Derrick Towers in Erecting a Steel-Frame Building

By W. A. Ehlers*

In the erection of the steel work of the Riggs Theater and Office Building on 16th and G Sts., Washington, D. C., two

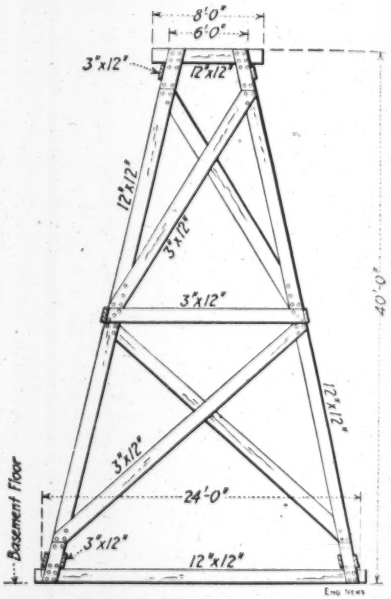


Fig. 1. Timber Tower for 25-Ton Derrick; Used in Erecting Steelwork of Riggs Theater and Office Building, Washington, D. C.

25-ton derricks were used, each having a 60-ft. boom and mast. The nature of the framing of the theater building would not permit of a setting of the derricks between the basement and sixth floor levels, and in order to raise the framework between these points a wooden tower for each derrick was constructed

*Supervising Engineer, J. H. De Sibour, Architect, Hibbs Bldg., Washington, D. C.

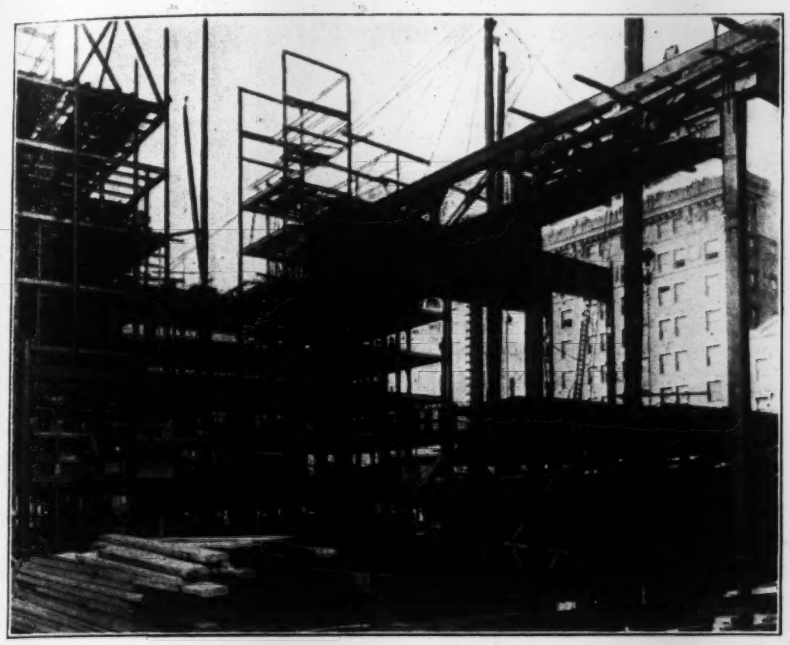


FIG. 2. ERECTING AUDITORIUM GIRDERS; RIGGS THEATER AND OFFICE BUILDING
(View from rear corner of stage; shows plate girder over proscenium opening and extra large truss carrying greater portion of three office floors over theater.)

as shown in Fig. 1.

This building is 116x178 ft., and is eight stories high. The theater section occupies about two-thirds of the floor area, the auditorium portion extending to the level of the sixth floor of the office section and the stage portion extending the entire height of the building. Fig. 2 shows the derricks and derrick towers in use during the erection of one of the large trusses over the auditorium.

The base of the tower was securely anchored to near-by columns at four or five different points by means of wire cables. In addition to the heavy framing at the top there were three pieces of 12x12 timber securely bolted to the framework. Upon this platform was set the derrick base block securely bound down by wire cable. The tops of the towers were guyed to near-by columns in the usual manner as were also the top of the derricks. The girders shown on the construction in Fig. 2 carry the sixth, seventh and eighth floors and the roof over the auditorium and from them are also suspended the second balcony girders. The top and bottom chords of the large truss each weighed approximately 25 tons and both derricks were needed to hoist them into place. The bottom chord was first hoisted into position and made fast to the columns at each end, besides being supported in the middle by a 12x12-in. strut resting on heavy wedge blocks which were driven up to keep the chord from sagging. After this the web members were set up and bolted to the bottom chord; then the top chord was lifted into place and the entire framework bolted together.

Methods of Depositing Concrete under Water

This was one of the subjects reported upon by the Committee on Masonry at the annual meeting of the American Railway Engineering Association, at Chicago, Mar. 17-21. The replies to a circular letter of inquiry covered nine methods, as follows: 1, bottom-dump bucket; 2, tremie (or closed chute); 3, open chutes; 4, sacks; 5, sacks withdrawn; 6, paper bags; 7, open depositing; 8, pneumatic grouting of broken stone; 9, concrete blocks. From an examination of the replies the committee has drawn the following conclusions:

1. Concrete may be deposited successfully under water, if so handled as to prevent the washing of the cement from the mixture.

2. Cofferdams should be sufficiently tight to prevent current through the pit, and the water in the pit should be quiet.

3. The concrete should be deposited in place either by means of a drop-bottom bucket or a tremie, and should not be allowed to fall through the water.

4. Where a bucket is used, it should be carefully lowered to the bottom and raised to the surface, so as to cause as little disturbance as possible of the water.

5. Where a tremie is used, it should be kept filled with concrete up to the top of the water level; the discharge end should be kept buried in the freshly deposited mass to prevent emptying, and raised a few inches at a time as the filling progresses.

6. The surface of the concrete must be kept as nearly level as possible, to avoid the formation of pockets which will retain laitance and sediment.

7. Where concrete is not deposited continuously, all sediment should be removed from the surface of the concrete, by pumping or otherwise, before depositing fresh concrete.

8. The concrete should be a 1:2:4 mixture and of a "quaking" consistency.

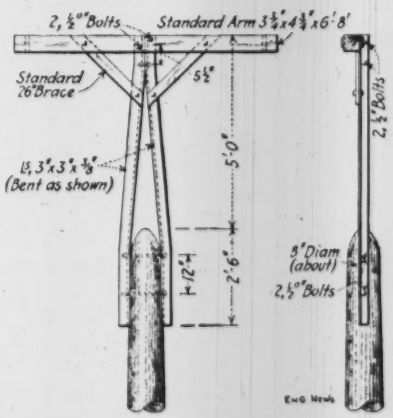
9. Freshly deposited concrete should not be disturbed.

10. In open water or where flow of water through the pit cannot be prevented, concrete should be deposited in cloth sacks.

Steel Extensions on Wood Distribution-Line Poles

BY L. W. R. ALLISON*

Additional height to many of the wires in service of the Pacific Light & Power Corporation, of Los Angeles, Calif., has recently been necessitated for the installation of new power lines along present routes. Unforeseen obstructions to low lines, such as new trolley roads, buildings, etc., have brought similar demands. To replace all short poles with longer ones would have resulted in enormous expense to the company, so that other ways out of the difficulty were sought. The height of the old poles has been increased by a top of steel angles as shown in the accompanying figure. The scheme has proved simple, effective and



AN ANGLE-IRON TOP FOR WOOD POLES; PACIFIC LIGHT & POWER CORPORATION

economical, particularly where it became necessary to run high-tension leads along the same route with primary and secondary lines, it being essential that the former be uppermost on the pole. In such case the lower-voltage lines did not require any change in position and the economy in labor was readily appreciated.

Two 3x3x⅛-in. angles were used; these were 7 ft. 6 in. long and, bearing on the pole for a distance of 2 ft. 6 in., afforded a clear additional height of 5 ft.

*1353 West 30th St., Los Angeles, Calif.

The sections were bent near the base to conform to the pole top, usually about 8 in. in diameter, and again about 9 in. from the top so that they could be placed back to back for that length. The angles are bolted through the pole with two ½-in. bolts, 12 in. apart, and again at the top with two ½-in. bolts 5½ in. apart.

The company's standard wood cross-arms were placed directly against the flanges of the angles and fastened thereto with ½-in. bolts. Additional support is made with the usual wrought-iron flats, bolted to the angles and crossarm as in regular construction. The increased height does not necessitate any additional pole steps for the lineman, as the cross-arm is easily reached by using the extreme top of the wood pole and the diagonal braces.

I-Beam Grillage in Place of Cast-Iron or Cast-Steel for Column Bases

The conventional base for columns of buildings is a cast-iron (or, in recent years, cast-steel) shoe, of sufficient size of bottom to suit the permissible loading of the stone or concrete foundation. E. W. Stern, Consulting Engineer, of New York City, has developed a base of the I-beam grillage type, as an improvement on cast bases. A typical design of his form of base is shown by sketch, Fig. 1, herewith. In a letter Mr. Stern gives the following comparisons:

1. In comparison with cast-steel bases, the grillage base is both cheaper and more reliable. In my own experience, I have had cast-steel bases develop cracks after having been erected, although they had been carefully annealed and inspected before leaving the shop. These had to be replaced after several stories of steelwork had been erected, which entailed very considerable expense.

2. In comparison with cast-iron, it is cheaper and very much more reliable. In an experience extending over many years in the use of cast-iron bases, I have known far too many to have developed cracks after they had been erected in the building, often entailing large expense for replacing them. For this reason I have not been using cast-iron bases for about 10 years.

3. The grillage form of base is easier to set properly, being much more readily grouted.

4. Stresses can be readily calculated (which cannot be said of the usual design of cast base). The conventional method of analysis for shear, crippling and bending is accurate enough for all practical purposes.

The design shown has been used for loads up to 1600 tons, and by slight modifications it may be used for much larger loads.

Shallow beams with heavy webs are preferred, avoiding the necessity of reinforcing the webs. However, Mr. Stern always uses stiffeners ground to fit, in the upper tier of beams, whether or not the calculations show them to be required.

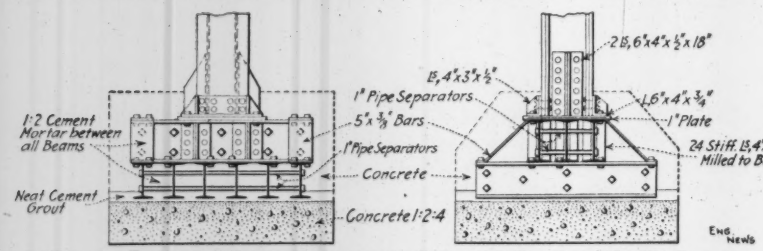


FIG. 1. TYPICAL I-BEAM BASE FOR A BUILDING COLUMN (E. W. STERN)

In building these grillage bases, the beams are bolted up complete in the shop, and each tier of beams is bolted together, ready for erection in one piece. Pipe separators should be used plentifully, and in the top layer they should be spaced not over 6 in. vertically and 8 in. horizontally. After setting, the base is, of course, grouted, all spaces between beams being filled with 1:2 portland-cement mortar.

The view Fig. 2 shows a base of this type set, ready for the column. A simple shoe-plate with angle brackets and stiffeners is used at the foot of the column.

FIG. 2. I-BEAM COLUMN-BASE SET READY FOR COLUMN

CONCRETE REINFORCED WITH WOOD was the subject of tests reported by G. O. Case before the Society of Engineers (London). He found that for equal strength of beam, 9% of wood reinforcement is needed as against 1% of steel. such beams are about 20% cheaper than creosoted pine wood and 40% cheaper than English oak.

Filing Drawing and Ma...

BY J. C. TRAUTWINE, 3D*

Referring to a query in ENGINEERING NEWS of Nov. 23, 1911, for a "Filing System for Maps," the following out... of the system used in the office of the Trautwine Company for filing drawings and maps is given:

Our maps are filed in our "Drawings" collection, laid out flat whenever possible, in flat drawers; but these drawers are provided, at the back, with open or half hinges, which, when the drawer is pulled out all the way, engage with suitable fastenings and permit the entire drawer to be tilted down to an angle of about 20° from the vertical, in which position it is held by swinging legs which may be seen in the illustration. The drawer is fitted also with a light frame hinged at the top of the drawer in front, and connected by chains to prevent excessive movement outward. This frame forms the front support of the drawings, etc., while they are being examined.

For the successful operation of so large a "vertical" file, a liberal use of "guide cards" is quite essential, as otherwise the papers will slump down and become badly wrinkled. In fact, it is necessary to use some care, when putting the drawer back into place, to see that all the papers lie out smoothly.

Other objections develop with other methods of filing: rolling takes up much room and is most inconvenient for reference; folding injures the papers. The choice is largely one between various evils.

Our maps are arranged by what might be called an alphabetical-geographical classification. Thus, first, in a general way, continents and countries are grouped, and the groups are arranged alphabetically. Then countries are subdivided into states, and these are arranged alphabetically among themselves. Again, the states are subdivided into cities or other arbitrary sections (names of sheets in the case of U. S. Geological Survey maps), and arranged alphabetically. Thus, the following maps would be arranged in the following order:

General maps
  Canada
  United States
    New Jersey
      Atlantic City
      Camden
    New York
      Binghamton
      Ithaca
      New York (City)
    Pennsylvania
      Philadelphia
      Pittsburg
    Vermont

Other subdivisions of cities may be made if desired.

Other than the alphabetical card index mentioned, no separate index to the classification or to the maps is maintained, each article indexing itself by being located in its proper place in the classi-

*257 S. 4th St., Philadelphia, Penn.

SPECIAL DRAWER FOR FILING MAPS AND DRAWINGS, IN TILTED POSITION
(Used by Trautwine Co.)

fication. It is found that, if the scheme of the classification is kept firmly in mind when looking for any particular article, there is seldom any serious delay in finding it.

If we were called upon to file detail maps of a city, we should perhaps subdivide by large well recognized districts, such as wards. If it were required to file maps of streets, showing water or other pipe lines, etc., it would probably become necessary to provide an index, because it seems impracticable to file data relating to more than one subject (as gas and water pipes) or locality (as two intersecting streets) so that it can be found in no matter what connection it may be wanted, without cross-referencing.

A Composite Map-filing Case

BY G. C. SCHERER*

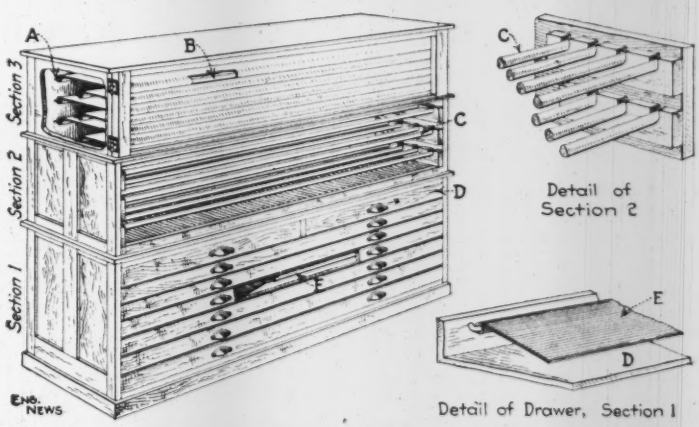
The accompanying cut shows a composite map-filing case. The first section, from the base up shows drawers, marked *D*. These drawers are of the ordinary construction, except that each one is provided with a hinged strip of heavy tin, zinc, or iron, as shown at *E* in the detail sketch. Raising the strip allows the edges of maps or drawings to come hard up against the front of the drawer, and then the strip is allowed to drop. This protects the edges of the drawings or maps from damage when opening or shutting the drawer. Actual experience proves it to offer absolute protection.

The second section is intended to preserve very fragile drawings. This consists of a system of rods *C* which fit into grooves or slots in transverse strips. The maps or drawings are wound about these rollers and the whole lifted out of the slots when desired for use, and replaced when not in use. This has also been found to offer great protection to very fragile drawings.

The third or top section is intended to be used for maps or drawings which are used frequently for reference. It consists of a system of window-shade rollers *A* to which the maps are securely tacked. The bottom edge of each map is tacked to a roller or strip *B* which is brought out beyond the stops, is labeled with the name or number of map, and can be pulled out just as a window shade is pulled down. When in use the map hangs down over the face of the case. When not in use the map is securely rolled up on the roller. The facing prevents the collection of dust, and keeps the maps in perfect condition.

The writer has never seen these units assembled in one case, but has frequently seen the separate items used with perfect satisfaction. The usual card or pamphlet index may be used, as suits the convenience or preference of the engineer. A map case as described may be made of any size to suit the necessity.

*Montgomery, Ala.



COMPOSITE MAP-FILING CASE (G. C. SCHERER)

Thawing Out Water Service Pipes by Electricity*

BY D. W. ROPER†

The Commonwealth Edison Co. has been thawing out water pipes with electricity for a number of years as an accommodation to customers. As the frost in the ground during the past few winters has not reached the water-service pipes this particular branch of the business has languished. But this winter there has been a great revival.

Up to January there had been no very cold weather, so that there was not more than about 18 in. of frost in the ground at that time. On account of the continued zero weather after the first of the year, the depth of frost in the ground rapidly increased, and by the middle of February the depth ranged between 5 and 6 ft. As the water pipes are laid ordinarily at a depth of 4 to 5 ft., the result has been that a large number of water pipes and a few water mains have been frozen.

The first calls for thawing out service pipes this winter came from a street where a trench had been opened in December during freezing weather, so that the earth was frozen when it was thrown out and could not be properly replaced when the trench was refilled. A few days later we had an inquiry from the city to learn whether we could thaw out water pipes, and as the city had never had any experience with this method they sent us a few trial orders. Finding the method entirely successful, orders began to come in more rapidly, and one gang was placed on this work in each of the three overhead districts. During the week ending Feb. 10, orders were received at the rate of about 50 per day. During the first three days of the following week the orders averaged 150 per day, and, as we were thawing out only one-third of this number, arrangements were made with the city to increase the number of gangs on this work, and all of our own available men were transferred from construction and ordinary maintenance work to pipe thawing. Wagons and automobiles were transferred from other work to this service, so that by the end of the week we had 18 gangs working on city pipe-thawing jobs and were thawing out more than 100 service pipes each day.

The output used in this work is very simple. Previous experience had taught us that a supply of current at about 55 volts would thaw out most of the water service pipes in a few minutes and without injury to them or to the mains. As none of our transformers are connected

*From the March number of the Journal of the Western Society of Engineers, Chicago.

†Assistant to the Chief Operating Engineer, Commonwealth Edison Co., Chicago.

An article describing the use of electricity in various cities for thawing frozen water mains can be found in Eng. News, Mar. 17, 1904, p. 251.

for this pressure, we arranged to reduce the pressure by connecting two transformers in series on the primary and in multiple on the secondary. These transformers can then be used without any regulating devices whatever, using the primary cutout as a main switch. As the visible supply of transformers decreased rapidly, the last few wagons fitted up for this work were equipped each with a single transformer so as to deliver 55 or 110 volts. In a few cases 6-in. water mains have been frozen up, and these were thawed out by the application of 110 volts.

The amount of current which flows in the water service pipes ranges between 200 and 300 amperes, depending upon the length of the service pipe. The time required to start the water varies from 5 to 15 minutes. In the case of the 6-in. water main, a current of about 600 amperes thawed it out in about one hour.

In thawing out service pipes, the owner of the building (or the city) has a plumber on hand who disconnects the service pipes from the house pipe at the building wall. One secondary wire is connected to the service pipe and the other to the nearest fire plug. When thawing out a street main the two secondary wires are connected to the fire plug at the two ends of the block where the main is frozen.

By the end of February we had thawed out over 1000 water service pipes, and the orders were being received as fast as we could handle them. A curious feature in connection with the work occurred on Monday, Feb. 19. The previous day was the warmest we had had in two months, the thermometer ranging above 50°. A great many people who had been allowing their water to run theretofore in order to keep the pipes from freezing noted the thaw, and assumed that the cold weather was over. In fact, there was still 6 ft. of frost in the ground, and the thaw which we had on Sunday did not penetrate more than an inch or two into the ground. As a result we received about 50% more orders for thawing service pipes on the day following the thaw than we had received on any one day up to that time.

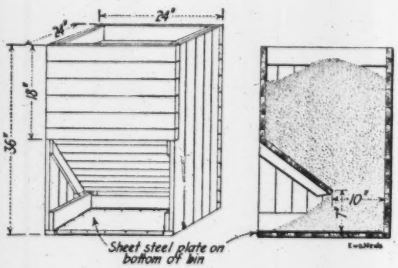
There have been a number of instances where service pipes have been thawed out a second time, and a smaller number where they have been thawed out three times. All of these orders have been received without any advertising whatever on the part of the company and have been done rather as an accommodation to the property holders and to the city. The total cost to the customers has averaged between $10 and $15 each, which is much lower than any other method of thawing out the pipes when they are frozen between the house and the street main. To dig up the ground and thaw out the pipes would have been considerably more expensive, and in addition it would make the pipes more vulnerable to the frost, as was shown by our first few cases, because the earth, haing been removed in freezing weather, could not be properly replaced in the ditch, so that the frost would penetrate the loosely packed frozen ground in the trench far more quickly than it would through the solid ground.

A Sand-Bin for Fire Use*

By W. R. Ruegnitz

For putting out fires in grease, varnish, paint, inflammable liquids, electrical machinery, calcium carbide and the like, where water lacks effect or even increases fire damage, common sand is valuable, and underwriters generally have required that pails or barrels of sand be provided, the latter to have "scoops" or "scoop shovels."

A 10- or 12-quart pail full of sand is heavy, generally lacking as to handles, and is therefore awkward to use. A barrel and shovel combination is much better, but by no means the handiest possible; you cannot dig into the top of a barrel and get out the shovelfuls of sand anywhere nearly so quickly, easily or conveniently as the exigency of the ordinary water-resisting fire demands. To demonstrate this, the best way is to take a barrel of sand and a shovel and start to dig. It might be of help to tip the barrel over so that the sand could be shoveled off the floor, but a full barrel of sand is heavy and not easily tipped. Quite possibly it may be placed or obstructed so that practically it cannot be overturned at all.



Bin for Sand Kept for Fire Extinguishing

To eliminate these disadvantages of pails and barrels, the hopper-bottom bin is suggested. The accompanying illustration is perhaps sufficient description in itself. The drawing shows a bin made of ⅞-in. pine, but No. 18 sheet steel may be substituted. The bin should be painted white or whitewashed, so that it may be seen readily even though interiors are poorly lighted, and enough bins should be provided so that sand can be thrown directly from bin to fire. The words "For Fire Only" should be stenc plainly on each bin.

The size of shovel which will be n efficient in fire protection has not b determined by any special test, but No. 2 D-handle square-point shovel commonly used by contractors for han ling fine sand and will give good servic The shovel should be fastened to bin b means of a light strap nailed on in such a manner that it can be pried off readil in case of fire, but may not conveniently be removed for other purposes.

*From an article in the April, 1912, issue of the National Fire Protection Association "Quarterly."

The Use of Slope-Stake Tables in Irrigation Work

By R. C. Pierce*

In cross-sectioning in connection with irrigation work, the writer has found it very advantageous to use tables giving the distances out to the cut and bank stakes for corresponding side cuts and fills. For large ditches and for very rough ground where there are large differences of elevation, the tables become cumbersome, but for ordinary ditch work he has found that by this method he can carry on the work faster and with more certainty of results, than by the ordinary method.

The instrumentman and the tapeman are each furnished with a cross-section table. The one for the instrumentman is copied on bristol board, and is of such a size that he can slip it between the leaves of his field book, allowing it to project out at the top so that the whole table is in sight.

With a ditch of 16 ft. bottom width, a bank 5 ft. wide on top and 4.2 ft. high, a 2½:1 inner slope and a 1½:1 outer slope, a table of the accompanying form is made, which can be extended to such limits as the roughness of the ground seems to warrant.

The table for the tapeman is best copied on a stick, about the dimensions of the ordinary cross-section stake, with the lower part cut down to form a convenient handle. The cuts with distances out are copied on one side, and the fills with corresponding bank stake distances on the other side. In using this table the tapeman can hold it in one hand and at the same time have both hands practically free to handle the tape.

In cross-sectioning by this method, the order of procedure is very much the same as in the ordinary method. The rodman holds the rod at the center stake and the instrumentman calls or signals the center cut. With this as a basis, and taking into consideration the slope of the ground and the size of the ditch, the tapeman estimates the difference of elevation between the ground surface at the center and the point on the side where he estimates the

*Hydraulic Engineer, U. S. Forest Service, Eugene, Ore.

inner slope of the ditch will cut the surface. Adding (or subtracting) this to the center cut as given by the instrumentman, he has the estimated side cut.

Looking on his stake table he finds the "distance out from center" corresponding to this estimated cut, and gives this distance on the tape to the rodman. On the point thus found the instrumentman takes a reading, and calls the cut. Usu-

SPECIMEN OF TABLE FOR SETTING SLOPE STAKES FOR IRRIGATION DITCHES

Cut distance	Cut	Fill	Bank distance
19.2	4.5		
19.0	4.4		
18.7	4.3		
18.5	4.2	0.0	23.5
18.2	4.1	0.1	23.6
18.0	4.0	0.2	23.8
17.7	3.9	0.3	23.9
17.5	3.8	0.4	24.1
17.2	3.7	0.5	24.2

ally this is within a few tenths of the cut as estimated. With the new cut, adding or subtracting a tenth or so as he sees that the correct point will be a little farther up or down hill, the tapeman takes the new "distance out from center" from his table and locates the rodman on the new point. The latter gives the instrumentman a reading and if the cut, as called by the instrumentman, does not check the last cut as assumed by the tapeman, the process is repeated.

For the bank or fill stake, the difference in elevation between the nearest center stake and the estimated location of the outer toe of the slope is found by the tapeman in exactly the same manner.

Since the tapeman can read the distance from his table as he is giving the distance with the tape, the time ordinarily given to computation is cut down almost to nothing. When the party becomes familiar with the cross-section of the ditch, the process of estimating the cut or fill, as outlined above, becomes more nearly an accurate guess than a process of calculation.

In the above described process the rodman should assist the tapeman by making an estimate of each cut or fill. The stakeman will have enough to do if he keeps up with the rest of the party. After the tapeman and rodman learn the system, they can keep the instrumentman on the jump giving them cuts and fills, and entering the final ones, with distances, in his field book.

The advantages of this system of cross-sectioning lie in the saving of time, the smoothness and ease of operation, the reduction of talking or signaling to a minimum, and the certainty of the results.

Motor Fire Engine Operating Costs are reported by the fire department of Roanoke, Va., where three of these engines have been in use five months. The average gasoline consumption was 9¾ gal. per mile; average miles per quart lubricating oil, 7; total cost—three engines for five months—$86.33 for fuel, oil and repairs. Horsedrawn engines would have cost $450 for the same period.

Tables and Diagrams for Setting Slope Stakes

By F. C. Snow*

The tables and diagrams described in this article are designed to be used with an ordinary slide-rule and may be made of such size as to be pasted on the back of the rule. To avoid having a number of different diagrams or scales for different base widths the diagram may be

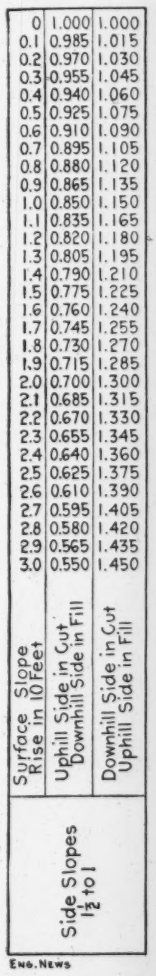

Surface Slope Rise in 10 Feet
Uphill Side in Cut Downhill Side in Fill
Downhill Side in Cut Uphill Side in Fill
Side Slopes 1½ to 1
Cuts or Fills
Bases
ENG. NEWS

TABLE AND DIAGRAM FOR USE WITH SLIDE-RULE IN SETTING SLOPE STAKES

made separate from the table and cut along the center line, so as to be adjusted for placing any base width at the zero of the A scale, as hereafter explained, by simply sliding the scales by each other.

A sample table and a diagram for cuts and fills with side slopes of 1½ to 1 are shown in the accompanying illustration. For different side slopes other tables and diagrams are necessary.

*Assistant Professor of Civil Engineering, Montana State College, Bozeman, Mont.

The column on the left gives the surface slopes of the ground at cross-sections expressed in feet of rise for a horizontal distance of 10 ft. This is found by actually taking levels on points 10 ft. each side of the center line, or in the case of preliminary estimates may be determined by scaling the distance from the station to the nearest contours, at right angles to the line.

The second column contains the ratios of the distance from center line to edge of cut or fill for level sections, to the distance for the section whose surface slope is given in the first column, the center cut or fill being the same in both instances. For the uphill side of cuts and the downhill side of fills, if c is the distance out for a level section, and x the desired distance out for a section of given surface slope, it can be readily proved by trigonometry that $\frac{c}{x} = 1 - 1.5 \tan A$, or $\frac{c}{1 - 1.5 \tan A} = x$, where A is the angle of surface slope, the tangent (multiplied by 10) of which is given.

Since the slopes vary by 0.1 and the tangents by 0.01, column 2 is easily computed by deducting 0.015 from each preceding value, in the case of a 1½:1 slope; for a 1:1 slope the difference is 0.01, and for 1:2 slope, 0.02. For the downhill side of cuts and the uphill side of fills we have the relation $\frac{c}{1 + 1.5 \tan A} = x$, and the ratio $\frac{c}{x}$ is given in column 3.

The A scale of the diagram on the right is a decimally divided scale representing cuts or fills. The inner scale of B is ½ the base (which is 4 ft. in diagram shown) + the distance out from toe of bank to where a level cross-section intersects the 1½ to 1 slope, or in other words, the slope stake distance for a level cross-section. The outer scale of B, which is double the inner scale, represents various base widths in cut or fill.

The use of the scales and tables is readily understood by an example—Given: base 4 ft., surface slope 0.9 (0.9 ft. in 10 ft.); center cut 6.3 ft. Set 4 on the base scale (outer B) opposite zero on the A scale. On the inner B scale (½ base + distance out) opposite a cut of 6.3 find 11.5 ft. In the tables under a slope of 0.9 find for the uphill side of the cut, in column 2, 0.865, and in column 3, for the downhill side, 1.135.

By the ratio previously referred to,

$$\frac{11.5}{0.865} = 13.3, \text{ and } \frac{11.5}{1.135} = 10.1$$

the required distances out to edge of cut or to slope stakes. For the cuts at these points we refer again to scales A and B, and under 13.3 find a cut on the A scale of 7.5 ft., and for 10.1, a cut of

5.4 ft. The complete cross-section notes now are:

$$\frac{13.3}{7.5\,(c)} \qquad \frac{0}{6.3\,(c)} \qquad \frac{10.1}{5.4\,(c)}$$

If the surface slopes are different on each side of the center line, this may be taken into account and each side determined separately as above.

When elevations are taken each side of the center line at the time the original levels are run, the approximate positions of the slope stakes and the earth quantities are readily computed beforehand, and the setting of the slope stakes for grading work can be accomplished very rapidly by following the cross-section notes already worked out.

These principles, of course, do not apply to irregular sections, but most of the cross-sections that occur in railway and irrigation work in the West have fairly smooth slopes.

For canal work where it is desired to place an embankment on one or both sides of the ditch, the following example will explain the use of tables and diagrams—Given: Top widths (bases of fills) 2 ft.; depth from top of bank to bottom of ditch 6 ft.; side slopes of bank and ditch 1½ to 1; center cut 3.2 ft.; surface slope 1.3; bottom width of cut 4 ft.

In the same manner as previously we find opposite cut 3.2 on the A scale a distance of 6.8 out to slope. Opposite the surface slope 1.3 in the table we find 0.805 and 1.195.

$$\frac{6.8}{0.805} = 8.4 \text{ and } \frac{6.8}{1.195} = 5.7$$

the distances out on the uphill and downhill sides, respectively. In the same manner as before the side cuts at these points are found to be 4.3 and 2.5 ft., respectively.

Now we have,

6.0 — 4.3 = 1.7 and 6.0 — 2.5 = 3.5. On the uphill side of the cut, 1.7 is the height of fill at the point where the cut changes to fill. To find the distance from this point to the center of fill: Set on base scale, the base in fill (2 ft.) opposite zero on the A scale. Opposite 1.7 fill find 3.6 for distance out. Opposite a surface slope of 1.3 in table find 0.805 for the downhill side in fill. Reversing the previous process, for we are now finding the center fill, having given the outside fill,

$$3.6 \times 0.805 = 3.0$$

Opposite 3 on the inner B scale find 1.3, the center fill. Now, as in the case of any fill we find uphill distance out, 2.5 ft., and the uphill fill, 1 ft. The fill on the downhill side of the cut is found in exactly the same manner, so the complete notes for the cross-section are:

Downhill

$$\frac{9.3}{5.5\,(f)} \quad \frac{0}{4.4\,(f)} \quad \frac{6.3}{3.5\,(f)} \qquad \frac{3.6}{1.7\,(f)} \quad \frac{0}{1.3\,(f)} \quad \frac{2.5}{1.0\,(f)}$$

$$\frac{5.7}{2.5\,(c)} \quad \frac{0}{3.2\,(c)} \quad \frac{8.4}{4.3\,(c)}$$

Uphill

Although rather difficult to explain, the operations are simple and, once understood, are quickly performed.

The methods of graduating the scales A and B are clear from their respective uses. The one illustrated was constructed as follows:

The B scale is made by laying off ½-in. divisions and dividing each of them into 10 equal parts, using each division as a unit for the inner scale and each ¼ in. as a unit for the outer scale. The A scale is made by taking ¾ in. as the unit division and dividing it into 10 equal parts.

Notes

Errata to Plate-girder Tables—In our issue of Jan. 25, 1912, pp. 162 to 165, we printed a set of tables for plate-girder design. The author, Mr. O. von Voigtlander, 303 Commonwealth Bldg., Jackson, Mich., finds a few errors in the tables as printed, and sends the following list of errata:

ERRATA

Size of angles	Depth of gird. or web	Change error	To	Size of cover plates	Depth of gird. or web	Change error	To
8x8x½-in.	72	1572	1557	20x¼	a	14.87	16.87
6x4x½-in	A	133.2	13.32	18x1/16	18	471	451
5x3½x½-in.	72	638	6.58	18x3	30	796	1596
5x3½x⅜-in.	45	138	318	18x2½	42	1780	1980
4x4x½-in.	24	228	218	18x⅜	66	688	668
4x4x⅜-in.	A	7923	7.23	18x1½	w	13,797	137.7
3x3x⅜-in.	A′	2.16	4.16	16x1½	45	890	898
Size of cover-plates							
54x 7/16-in.		364	304	16x1½	72	1594	1549
33x1 1/16-in.		494	474	16x1½	w	063.2	163.2
33x1 3/16-in.		596	516	16x2½	w	213	231
27x1½-in.		492	472	12x3	24	807	817
33x1½-in.		557	577	12x2½	27	686	868
39x1½-in.		719	731	12x1½	a	07.5	17.5
30x2-in.		690	600	10x7/16	72	234	254
27x2½-in.		594	574	8x7/16	24	64	84
33x2½-in.		791	701	14x2½	54	1416	1614
39x2½-in.		024	1024	14x1	66	680	806

A Solution of the Printing Press Gear problem, in addition to those mentioned in our issue of Apr. 25, 1912, has been received from Prof. A. H. Gibson, of the engineering department of the University of St. Andrews, Dundee, Scotland.

Red-lead Poisoning from Old Paint—Last spring a hull compartment of the U. S. torpedo-boat destroyer "Chauncey" was to be repainted and a number of men were set to work chipping and scraping out the old paint, which appears to have been a red-lead paint. In a short time three of the men were in hospital with symptoms difficult to diagnose, but later found to be severe lead poisoning. Medical Inspector E. R. Stitt, U. S. Navy, reports on these cases in the "U. S. Naval Medical Bulletin," April, 1912. As he had not previously been familiar with lead poisoning by the inhalation of red-lead laden dust he made some experiments on rabbits to determine whether this mode of introducing lead into the system is as poisonous as other means of introducing lead. The experiments did not settle the question directly, but they indicated that poisoning was readily produced by inhalation of lead powder. A special feature of the three cases from the "Chauncey" was that the patients showed mental derangement. One case showed successive onsets of a kind of insanity and the last encephalopathic symptoms were not removed until 10 months after the p[ai]oning. Another of the cases was at f[irst] thought to be dementia praecox, but t[he] case was soon found to be lead poi[s]ing and was cured in a month. The th[ird] case was recognized as lead poison[ing] from the outset, and was cured in t[wo] months by eliminative treatment. T[he] extensive use of red-lead priming co[at] on steelwork and the frequent necess[ity] for removing old paint prior to repair[ing] make these cases of poisoning of special interest to engineers concern[ed] with the maintenance of steel structur[es].

The Shape of a Concrete Test Piece seriously affects its strength in compression according to some recent tests made at the University of Illinois. These tests, a part of a concrete column investigation, were made simultaneously on 6-in. cubes and cylinders, 8 in. diameter by 16 in. high, molded from the same mix. Of the 19 specimens one was a 1:1:2 concrete, two were 1:3:6 and the rest were 1:2:4. The accompanying table shows the superior strength of the smaller cubes. An average of all the tests shows that the cylinders were only 68% as strong in compression as the cubes.

UNIVERSITY OF ILLINOIS TESTS
Sixty-day Compression Tests

6-in. cubes (Lb. per sq.in.)	8x16-in. cylinders (Lb. per sq.in.)	Percentage
1790	1350	75
2430	1490	61
1420	1140	80
2150	1260	59
1320	970	73
1970	1150	58
2970	2420	81
*3280	2520	77
†1320	700	53
†1440	660	46
1760	1370	78
2020	1330	66
1670	1280	77
1440	1160	81
2070	1340	65
2270	1330	59
1780	1110	62
1620	1460	90
1980	1120	57
Average		68

*1:1:2 concrete.
†1:3:6 concrete.
All other pieces of 1:2:4 concrete.

Similar figures in a recently published report of the U. S. Bureau of Standards seem to show that the strengths of cylinders and cubes approach each other in time. These tests were also upon 6-in. cubes and 8x16-in. cylinders (8 in. diameter), four kinds of aggregate and extend over 52 weeks. The following table shows the results of the average of 22 comparisons in each kind of aggregate, that is, each figure represents 22 cubes and 22 cylinders. The ratio is that of the cylinder strength to the cube

strength. A 1:2:4 concrete was used in each case.

BUREAU OF STANDARDS TESTS

	Granite	Limestone	Gravel	Cinder	Average
4 wks..	0.803	0.735	0.794	0.763	0.774
13 " ..	0.823	0.814	0.846	0.862	0.836
26 " ..	0.849	0.839	0.880	0.935	0.876
52 " ..	0.852	0.886	0.928	0.886	0.888

The first table above is abstracted from University of Illinois Bulletin No. 56, "Tests of Columns: An Investigation of the Value of Concrete as Reinforcement for Structural Steel Columns," by A. N. Talbot and A. R. Lord. The second table is abstracted from Technologic Papers of the Bureau of Standards, No. 2, "The Strength of Reinforced-Concrete Beams" (First Series), by R. L. Humphrey and L. H. Losse.

The Action of Certain Liquids on Concrete is noted as follows in a translation from "Zentralblatt für hydraulische Zemente," in "Cement and Engineering News":

SUGAR SOLUTIONS AND SYRUP—Pieces of concrete were placed into a glass jar and covered with a 20% pure sugar solution and left there for three months under occasional stirring. After a few days a white flocculent sediment appeared on the surface of the concrete which fell off. After about three months the entire solution had a dark-brown color and contained a brown deposit. Analysis showed that aluminum oxide, iron and lime had gone into solution. The structure of concrete was loosened, proving that concrete vats should be used carefully for a sugar solution.

GLYCERIN—This shows the same results, though somewhat weaker. Iron oxide did not dissolve, but aluminum oxides dissolved in large quantities.

GAS AND AMMONIA WATERS—Ammonium sulphate and ammonium carbonate as well as ammonia liquor have an injurious influence on concrete. The ammonia colors the concrete a dark color, and the ammonia sulphate forms iron sulphide and takes on a grayish-black color. As long as the concrete is completely covered with the liquid the structure is not destroyed. Ammonium carbonate causes no visible mechanical changes and the chemical analysis of the solution gave traces of iron only. As long as cement tanks are always filled with these liquors they can be used without trouble. But if they come in contact with the air and then again with the ammonia liquor the soluble iron sulphate is formed with the resulting destruction of the concrete tank.

A Public-land Survey Error—The largely unwritten history of contract surveying of the U. S. public lands is touched on in the following story of a nice incident:

Sir: I have seen large comment in the "News" as to mistakes, errors, etc., etc., in the Government land surveys. Among the many I have experienced the most curious was one about 75 miles north of Brainerd, Minn., which I think takes the cake:

In running the N. and S. township line commencing at the southwest corner, the U. S. surveyor went up half a mile and put in the quarter stake, then eighty rods farther and put in the section corner. He carried that error to the north line. The northwest corner of the township was in a big lake, which as I remember it extended about a mile, or near to the southwest corner of Sec. 6. When the next U. S. surveyor subdivided, he ran north between 31 and 32, put in quarter and section corners, then ran a west random to the northwest corner of 31; of course he didn't find any section corner and concluded they didn't put any in (not a strange occurrence, as I have had instances where all that was done was to WRITE UP THE NOTES and never do any surveying at all). Therefore he put one in (marked his witness trees, etc., all in heavy pine timber). Then he went up between 29 and 30 and ran a random west again; by that time, finding no corner, he began to investigate and probably found the trouble. Having been undoubtedly a mother himself, he didn't give the other fellow away. However, his survey showed he closed on all the section corners (which he didn't) to the north line of the township. He then returned and obliterated as well as he could the witness trees at the corner to 30 and 31; however, he blazed the lines east and west between all the sections approximately where they should be.

The timber cruisers for various lumber companies knew there was something the matter, but not what, and I was sent up there to find out. The land was all owned by wealthy lumber companies, who all agreed that the facts should be submitted to the Commissioner of the General Land Office and his decision be final. I reported the facts, and the Commissioner ruled that the correct location of the north boundaries of the west halves of all the west tier of sections must run southwesterly from the north quarter stake to the section corner as located on the ground; of course the same thing in the east tier of sections of the township west.

The most notable was probably the case of Section 30, which had land enough for 22 forties instead of 16, and being on the Vermillion Iron Range overlaid rich iron deposits. That was back and forth in the Supreme Court of Minnesota for some ten years to my knowledge; I don't know whether it is fully decided yet.

E. T. ABBOTT.

Thrall, Calif., Apr. 17, 1912.

Loose-Leaf Surveyors' Note-Books have been tried with success in several instances, and their adoption on the Lehigh Valley R.R. for preliminary and location surveys will be of interest to engineers of other railways. Mr. C. A. James, Assistant Engineer at White Haven, Penn., sends the following description:

The cards are 5x8 in., and are carried in a cover and carrying case as shown in the accompanying illustration. The note-book is rather large for convenience and the cards might be of lighter stock, otherwise they prove quite satisfactory in the field. The cards for a day's work are turned into the office at night, plotted the next day, and filed in filing boxes, properly indexed, so that when wanted they can be found in a few seconds. There is no waiting for the field party to return in order to use certain notes. If the notes are to be checked, three or four men may be employed instead of one. The cards are ruled in the five forms ordinarily used in surveyors' field books, and with guide cards and filing boxes cost $18 for 2000. The cover and carrying case cost $3. This outfit has proved well worth the money invested.

LOOSE-LEAF SURVEYORS' NOTE-BOOK

Transit Stadia Attachments—The device for reading stadia distances and elevations direct, invented by Prof. R. L. McCormick and described by him in our issue of Apr. 25, brings to mind a somewhat similar but less elaborate device known as the Beaman stadia arc, invented by W. M. Beaman, a topographer of the United States Geological Survey, in 1904, patented in 1906, and now manufactured by W. & L. E. Gurley, of Troy, N. Y. The Beaman device consists simply of a circular arc fastened to one of the transit standards inside of the regular vertical arc or circle. This stadia arc carries two scales: a multiple scale, used only for elevation determinations, and a reduction scale, used to reduce inclined stadia readings to horizontal distances. Either scale is read by reference to an index, also attached to a standard and adjusted to read the zero or initial points of the scales when the telescope is level.

The initial graduation on the multiple scale is 50 instead of zero, so that its direct reading will indicate, and the notes afterward show, the sign of the vertical angle; to obtain the desired multiple, it is, therefore, necessary to subtract 50 from the scale reading. Differences of elevation are determined by setting a whole number (as 42) opposite the index, so that the middle stadia wire in the instrument will fall on the rod. The arc reading less 50, times the observed stadia distance (rod interval), minus the rod reading, equals the difference of elevation. When one of the other horizontal wires is used, allowance is made for the rod interval between it and where the middle wire would fall on the rod extended.

Distance is found by multiplying the direct reading on the reduction scale by the rod reading (multiplied by 100) and subtracting this correction from the distance indicated by the rod interval.

This device has been used successfully for a number of years by the United States Geological Survey for topographical work.

Shore Triangulation with Floating Target—An unusual method of extending secondary triangulation along the shores of the Great Lakes is used in the United States Lake Survey, which is under the supervision of officers of the Corps of Engineers, U. S. A. Triangulation stations near the shore, at intervals of from three to eight miles, are necessary for controlling the detailed hydrographic and topographic surveys which follow. On the banks of a river or estuary the ordinary method, of course, is to work from one side to the other, the base of a triangle being on one bank and the vertex on the opposite bank; and on a rugged coast with projecting headlands and outlying islands

little trouble is found in developing a satisfactory triangulation net. But on the Lakes, with miles of regular shore line and no islands, the problem of establishing shore triangulation points required a special solution.

The method here used is briefly described by C. S. Johnstone in the "Polytechnic" of the Rensselaer Polytechnic Institute for Apr. 10, 1912, from which we have taken the following data:

After two stations have been accurately established the position of a third is determined by triangulation, using the mast of one of the Survey steamers as the common vertex of the two adjacent triangles. Suppose, for example, that the two stations A and B are established and it is desired to fix the position of a third point C farther along the shore. The steamer is taken out into the Lake and anchored in such a position D, that the whole angle at D, from A to C, is approximately equal to 180° — ½ the whole interior angle at B, this making a strong system. A satisfactory position for D is found from the chart, and data given to the captain of the steamer which will enable him to anchor approximately in this position.

As the steamer is not entirely stationary, angles are read simultaneously from each of the three shore stations at 4-min. intervals. Pointings are made from the instruments on shore and on the dropping of a signal device on the steamer's mast, the instruments are clamped and the angles noted at each station. Twenty sets of observations are made. The procedure for the observer at A would be as follows:

Sight on B, telescope direct.
Sight on D (steamer), telescope direct.
Sight on D (steamer), telescope reversed.
Sight on B, telescope reversed.

Shift the limb 18° and repeat the procedure in the reverse order, then make another shift of 18° and continue in a similar manner to a total of 20 observations. The recorder notes the time of each setting and the mean of the micrometer readings for each.

The difference in azimuth between the measured base lines A B and B C is read separately and the mean of ten observations used to compute the triangles, which fix the position of C. This method is also briefly referred to in "The Principles and Practice of Surveying," by Breed and Hosmer.

United States Coast and Geodetic Survey work in 1911 shows marked progress in many branches. It used to be thought that when the coasts were once surveyed the Coast and Geodetic Survey could be disbanded, and many of the earlier Superintendents encouraged Congress to make appropriations upon that basis. So, for a long period appropriations were somewhat grudgingly made. Since the acquisition of Alaska, the Hawaiian Islands, the Philippine Islands and Porto Rico, the Survey has not lacked new coasts to chart, and much work remains to be done on our own coasts, as Mr. O. H. Tittmann, the present Superintendent, has clearly shown.

The recent great development in motor boating, the largely increased size and draft of merchant and war vessels, the natural changes in the bars and shoals, the finding of new rocks and obstructions, and the improvement of rivers, channels and harbors are among the conditions which make the survey of our own coasts an endless task.

Many waterways but little frequented when the original surveys were made are now used extensively, and consequently there is an urgent demand for accurate charts of inland waterways along the coasts. The positions of lighthouses and other aids to navigation must be accurately determined, and, finally, important channels and harbors must be carefully gone over with a wire drag to make certain that no hidden dangers have been overlooked by the ordinary methods of hydrographic surveying.

The Survey is intrusted with the charting of 50,000 miles of coast line. Aside from the work done by the field force of the Survey, many reports and data are obtained from other sources, which are used in chart corrections.

The work of marking the boundary lines between the United States and Alaska and Canada also devolves on Mr. Tittmann and the officers of the Survey, on the part of the United States. Much of this work is in the wildest, coldest and most barren of countries, where the surveyors experience many adventures and trials.

Besides this geodetic work the Survey is engaged, and has yet much to do, in primary triangulation and precise-leveling within the boundaries of our own country. As an aid to mariners and surveyors constant study of magnetic variation is being made, and many observers are kept in the field for this purpose alone. The annual report of the Superintendent, recently issued, contains magnetic data for many new stations and the geographical position of 1500 triangulation points, carefully and fully described, which will prove of value to engineers and surveyors. The appropriation of the Coast and Geodetic Survey for the current year was $1,005,120.

Cracked Crane Hooks are reported on by C. Canaris, in "Stahl und Eisen," of Apr. 11, 1912. In the case he reports the hook links at the sides of a yoke for carrying ladles of molten steel showed cracks on the side facing the ladles, but the cracking developed only in those hooks nearest the open end of the furnace building (and thereby exposed to the weather). It was concluded that the cracking was due to the combination of local heating from radiation from the iron, and chilling from weather exposure. The material of the hooks proved to be a steel of moderately hard structural grade, which had been purified by silicon addition. He concluded that a softer steel without silicon addition should be used for such hooks. Discussion of the subject by others (also reported) indicates that in similar cases very coarse crystal formation results from local heating; a case where the lower side of a ladle yoke cracked was reported. The hooks are often found to be highly brittle, breaking under side shocks even without load.

The Care of Chains—"The most general cause for discarding chains is breakage. In many instances this is caused by the want of annealing. Chains which are thoroughly well made and which have been tested before leaving the works are yet likely, after continued hard usage, to break in the most unexpected manner. The remedy for this tendency is annealing or reheating. To be kept in condition, all chains in general use should be annealed at least every six months. It is best, of course, if they can be sent to a furnace of some sort, but it has been found that a good job of annealing may be done anywhere by simply building a bonfire around and under the chain to be annealed and firing it up until the chain becomes cherry red, after which it should be allowed to cool slowly. If this is done with sufficient care and frequency the life of the chain may be prolonged many months.

The breakage of chain is often due to the carrying of excessive loads. Loads in excess of one-half the proof loads of chains should be avoided if it is desired to get long use out of them. A small chain should not be expected to do the work of a larger one.

Another way of wasting chains is to allow them to drag on the ground and so by constant abrasion be worn out. Chains placed on sheaves or drums at too acute angles wear out rapidly. All chains used in hoisting and conveying machinery or over pulleys and drums should be kept well lubricated. This may be done with a brush, and should be attended to weekly at least. Care should be taken to allow no sand or grit to accumulate in the links to cause rapid wearing."—From a pamphlet published by the Jones & Laughlin Steel Co.

Bridge Records Missing—Formerly the calculated factors of safety of the compression members of a large number of railway bridges in Prussia were not known, because there were no records of strength calculations, and, in fact, for many bridges there were no drawings. This condition lasted until the beginning of the nineties of the last century. It was true not only for the old railways, but even in the case of a railway opened in 1883, whose bridge drawings and calculations could not be found in 1895.

In 1895, in order to secure better supervision over bridges, it was ordered that the most important dimensions and data of the structure and its stresses should be recorded for each structure in a "bridge book." When this order was carried out the unexpected result developed that for thousands of bridges no calculations of stresses were on hand. For a large number there were no drawings. To improve this condition required a number of years' active work. The new "bridge books" soon showed that many structures were too weak for the loads they were carrying, and still more inadequate for the increased traffic loads which might be expected in the future. This led to extensive reinforcement of many bridges and the complete replacement of many others. [Dr. H. Zimmermann in "Zentralblatt der Bauverwaltung," Apr. 10, 1912.]

Efficiency Engineering 40 Years Ago is described by a correspondent to have been quite effective in the building of a large banking house in Philadelphia, Penn. The rate of hod-carrying up ladders for three stories was raised to a maximum in this way: The trick was to find a negro with a good sound heart and a first-class pair of lungs on a stout pair of legs. This darky was paid $5 a day at a time when the other hod-carriers got $2.50. But the condition on which he worked was that he should break the record and lead the line up the ladder. The rest of the line in that day were Irishmen. Therefore, they hated a darky and on general principles asserted the superiority of the white man. They had to be consistent to their assertions and principles. The result was a stream of brick-laden humanity mounting up those ladders with a celerity not to be beaten by the methods of a modern efficiency expert.

Approximate Radii of Gyration

By O. von Voigtlander*

No column formula exists which will give both the necessary area and the corresponding slenderness ratio of column to fit the form of section selected, without some assumptions. Column design is therefore a matter of trial and error. The usual formula $P = Sa$ contains two variables: S, the allowable unit stress, and a, the cross-sectional area. To determine S the designer uses a column formula which, however, contains the radius of gyration r, in some form or other. Thus, the radius of gyration of the section must be known (or estimated) before the size of the section can be determined.

To facilitate this work and to give some idea as to the necessary size of column to carry a given load, the accompanying table has been compiled. Quite often outside conditions limit the dimensions of the column, and it is then convenient to be able to determine, without laborious calculation, the largest value of r that can be obtained for the given overall dimensions. Besides giving the approximate radii of the simple rolled sections which may be used as columns, the values of the more common built-up building and bridge sections are given.

The individual formulas have been tried out pretty thoroughly, and if some judgment is used the values of r obtained by this table will agree with the finally-computed values within about 1 or 2%. They are therefore amply sufficient to guide the designer in determining preliminary shape and size of column. Of course, bad judgment in using the formulas will give faulty results. As a glaring example of bad judgment, take the section composed of two channels back to back, No. 19, for which the radius about the y-axis is given as 0.6 b. This value will not apply if the channels are placed with backs actually in contact, but so long as the channels are placed a distance apart equal to about 63% of h or the nominal size of channel, the results will be satisfactory.

*With Wm. G. Fargo, 303 Commonwealth Bldg., Jackson, Mich.

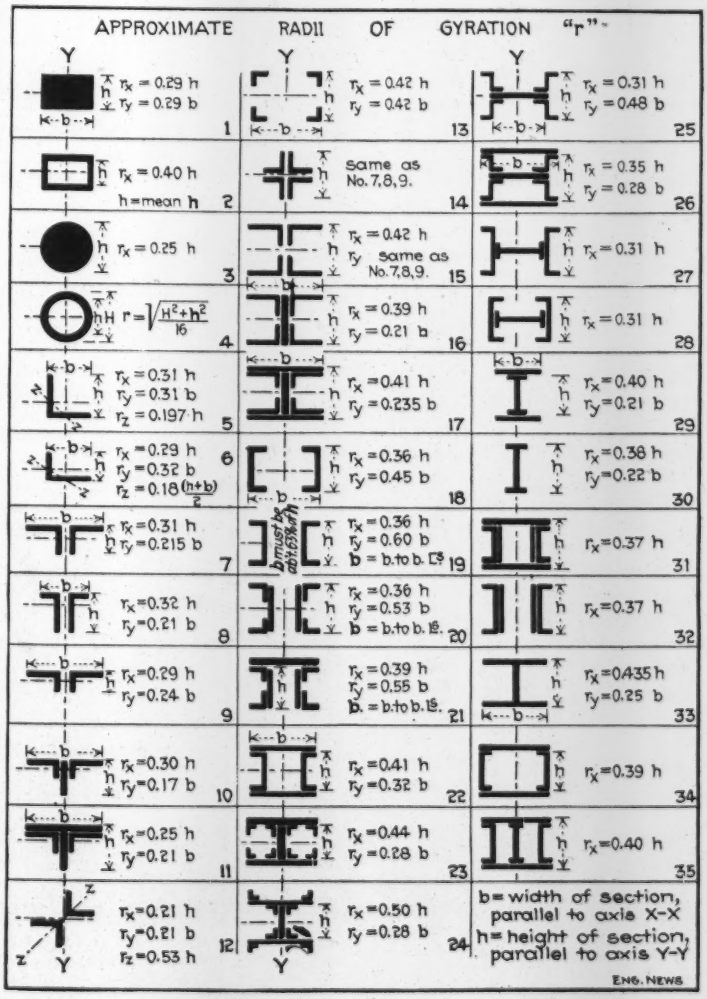
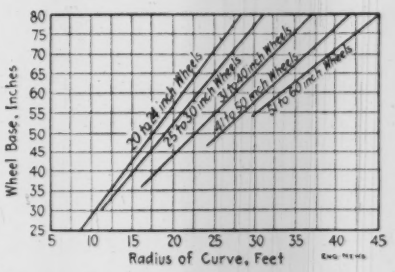

APPROXIMATE RADII OF GYRATION "r"
1 $r_x = 0.29\ h$ $r_y = 0.29\ b$
2 $r_x = 0.40\ h$ h=mean h
3 $r_x = 0.25\ h$
4 $r = \sqrt{\frac{H^2+h^2}{16}}$
5 $r_x = 0.31\ h$ $r_y = 0.31\ b$ $r_z = 0.197\ h$
6 $r_x = 0.29\ h$ $r_y = 0.32\ b$ $r_z = 0.18\frac{(h+b)}{2}$
7 $r_x = 0.31\ h$ $r_y = 0.215\ b$
8 $r_x = 0.32\ h$ $r_y = 0.21\ b$
9 $r_x = 0.29\ h$ $r_y = 0.24\ b$
10 $r_x = 0.30\ h$ $r_y = 0.17\ b$
11 $r_x = 0.25\ h$ $r_y = 0.21\ b$
12 $r_x = 0.21\ h$ $r_y = 0.21\ b$ $r_z = 0.53\ h$
13 $r_x = 0.42\ h$ $r_y = 0.42\ b$
14 Same as No. 7,8,9.
15 $r_x = 0.42\ h$ r_y same as No. 7,8,9.
16 $r_x = 0.39\ h$ $r_y = 0.21\ b$
17 $r_x = 0.41\ h$ $r_y = 0.235\ b$
18 $r_x = 0.36\ h$ $r_y = 0.45\ b$
19 $r_x = 0.36\ h$ $r_y = 0.60\ b$ b = b.to b. ☐
20 $r_x = 0.36\ h$ $r_y = 0.53\ b$ b = b.to b. ☐
21 $r_x = 0.39\ h$ $r_y = 0.55\ b$ b = b.to b. ☐
22 $r_x = 0.41\ h$ $r_y = 0.32\ b$
23 $r_x = 0.44\ h$ $r_y = 0.28\ b$
24 $r_x = 0.50\ h$ $r_y = 0.28\ b$
25 $r_x = 0.31\ h$ $r_y = 0.48\ b$
26 $r_x = 0.35\ h$ $r_y = 0.28\ b$
27 $r_x = 0.31\ h$
28 $r_x = 0.31\ h$
29 $r_x = 0.40\ h$ $r_y = 0.21\ b$
30 $r_x = 0.38\ h$ $r_y = 0.22\ b$
31 $r_x = 0.37\ h$
32 $r_x = 0.37\ h$
33 $r_x = 0.435\ h$ $r_y = 0.25\ b$
34 $r_x = 0.39\ h$
35 $r_x = 0.40\ h$
b = width of section, parallel to axis X-X
h = height of section, parallel to axis Y-Y
ENG. NEWS

Diagram for Curving Ability of Railway Vehicles

A diagram which will frequently be found useful is reproduced herewith from the *Electric Journal*, of November, 1911. It was prepared by Graham Bright, and was calculated from a formula given by the Baldwin Locomotive Works in their handbook, "Locomotive Data." The formula is

$$R = \frac{1}{2}\frac{W}{\sin a}$$



Relation between Rigid Wheel-Base and Sharpest Curvature for Railway Vehicles

in which

R = Radius in feet of the sharpest curve which can be passed;

W = Wheel-base in feet;

a = Angle which flanged wheels make with rail.

This angle is given for different wheel diameters as follows:

Wheel diameter	sin a
20 to 24 in.	0.117
25 to 30 in.	0.107
31 to 40 in.	0.090
41 to 50 in.	0.080
51 to 60 in.	0.075

The diagram is based on a gage of track on the curve equal to that on tangent. If the track gage is spread on curves, the wheel-base values for given radius of curve may be increased 10 to 25%.

The Strength of Annealed Steels is discussed by Prof. Albert Sauveur in "Journal of the Franklin Institute" of May, 1912, with the result of deducing the following formulas:

For hypo-eutectoid steel, i. e., steel below about 0.85% carbon, the tensile strength T in terms of carbon percentage C is,

$$T = 50{,}000 + 90{,}000\ C,$$

the ductility (elongation) in per cent. is

$$D = 40 - 36\ C,$$

and the reduction of area in per cent. is

$$R = 60 - 54\ C.$$

For steels above 0.85% carbon the tensile strength is

$$T = 142{,}000 - 20{,}600\ C.$$

All these formulas apply only to slowly cooled steel, which as a result of slow cooling contains pearlite. Cold working and other influences alter these values.

The formulas are based on a pearlite strength of 125,000 lb. per sq.in., ferrite strength of 50,000, and cementite strength of 5000 (doubtful). The elongation of ferrite (in 2 in.) is taken as 40%, and that of pearlite as 10%.

Letters to the Editor

Substitution of Hypochlorite for "Electrozone" at Brewster, Croton Water Supply, New York City

Sir—Mention is made in your issue of Mar. 21 (p. 534) of the Electrozone Plant built at Brewster, N. Y., in 1893, by the City of New York, for the purification of the sewage from a few houses before its discharge into a small brook in the Croton drainage area.

As a matter of completing your record, it may be stated that this plant burned to the ground during July, 1911, and that upon its site a new structure was erected which sterilizes the sewage from the major portion of the village of Brewster, and in addition, the flow of Tonetta Brook, the tributary mentioned by you, by the use of a chloride of lime solution.

I. M. DE VARONA, Chief Engineer
Department of Water Supply.
New York, May 1, 1912.

Cohesion, and the Plane of Rupture in Retaining Wall Theory

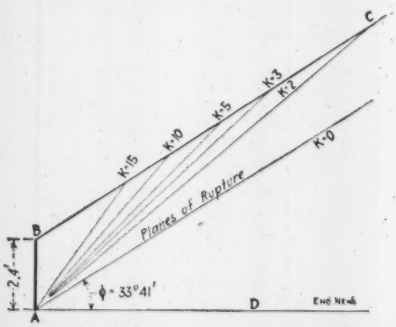
Sir—In your issue of Apr. 25, 1912, p. 799, M. Hirschthal writes relative to "Some Contradictory Retaining Wall Results." Apparently the "contradiction" was found from the author assuming that the plane of rupture, for the earth surface sloping at the angle of repose, bisected the angle between the vertical and the natural slope. On the contrary, as the supposed (plane) surface of the earth approaches the natural slope the corresponding plane of rupture approaches indefinitely the natural slope. This is involved in the author's first formula, which is consequently the only one applicable to this case where cohesion is neglected. As a matter of fact, however, cohesion is always present and its influence often materially modifies the results, as the writer has shown in a recent paper* on "Experiments on Retaining Walls," where a complete graphical solution for finding the earth thrust against a wall is given, the earth being supposed endowed with both friction and cohesion.

Fig. 13 of that article is here reproduced. It refers to a vertical wall AB = 2.4 ft. high, backed by earth whose surface BC is inclined to the horizontal at the angle of repose, 33° 41′.

The straight lines drawn from A to BC give the planes of rupture for k = 2, 3, 5, 10 and 15, where k = cohesion of the earth filling in pounds per square foot. For k =0, the plane of rupture as stated above is parallel to BC.

For a wall 12 ft. high, the same planes of rupture correspond to values of k five times as much, and for a wall 24 ft. high to values of k ten times those given on the figure. Thus, for a wall 24 ft. high the plane of rupture for k = 20 would coincide with the line AC corresponding to k = 2 for the wall only 2.4 ft. high.

The horizontal thrusts on the wall AB, 24 ft. high, for earth weighing 80 lb. per cu.ft. for k = 20 and k = 0 respectively, are in the ratio 0.237 to 0.345, or about in the ratio of 2 to 3.



Leygue found, for a "damp fresh earth," k = 18.45, so that it is probable that the value k = 20 lb. per sq.ft. is often realized for fresh filling. The greater the height of the wall, the greater the value of k, since consolidation is more pronounced; but the influence of cohesion, for the same k, decreases as the height of wall increases. These influences may sometimes counterbalance each other, but generally the latter is most pronounced in its effect on the thrust.

The writer has shown (in the article cited above) that all the experiments on rotating retaining walls or boards backed by sand can be harmonized with the theory proposed, when both wall friction and cohesion are included. Experiments can only properly be interpreted when the influence of cohesion is considered.

For *design*, it would seem unwise to include cohesion, simply because we know so little about the coefficients of cohesion of different earths and they vary so as the earth passes from the fresh, pulverulent to the consolidated state. Thus, experiments seem to indicate that k for dry sand is but little above 1; for damp, fresh earth perhaps 15 to 20; whereas for consolidated earth, in which trenches can be dug with unsupported vertical sides 15 to 25 ft. high, a computation shows that k is 200 and 300 lb. per sq.ft. for the two cases.

Numerous experiments in the future may give us these values of k desired, but until then, to be on the safe side, it is well to ignore cohesion in design.

For level fill, if the thrust on the vertical wall AB is assumed horizontal, as in the Rankine theory, then the plane of rupture for any value of k (zero included) bisects the angle between the natural slope and the vertical. Since cohesion thus acts upon a less area than for the case shown by the figure, the influence of cohesion in diminishing the thrust is less marked when the fill is level at top than when it slopes at the angle of repose. In conclusion, it is plain that there is no connection between the two methods proposed by Mr. Hirschthal for the solution of his problems, and hence no contradiction.

WM. CAIN.

Chapel Hill, N. C.,

*Trans. Am. Soc. C. E., Vol. LXXII, pp. 403-474.

Early European Data on Forests, Floods, Rainfall and Runoff

Sir—Apropos of my letter in your issue of May 2 on the subject of forests and floods, I would like to call your attention to some facts presented in Koester's "Hydroelectric Developments and Engineering," published by Van Nostrand in 1909. The facts seem to be so pertinent to the lively controversy in this country during the past two or three years that I quote as follows from pages four and five:

According to the report by the Swiss engineer, Lauterberg, the drainage of the canton Tessin, between 1834 and 1862, was reduced about 28%, due to the removal of forests. He states further that prior to the destruction of forests the valleys were flooded, on the average, every 54 months, while after the forests were destroyed floods occurred every 29 months. Prof. Ebermeyer states that, considering the evaporating factor of free land as 100%, the evaporation of the forest land is only 22%, other conditions remaining the same. Dr. van Bebber observed that a forest at an elevation of 1000 meters (3280 ft.) has about 50% more drainage than free land situated on the same elevation. Relative to this, Prof. Schreiber, who observed

conditions in Saxony, came to the conclusion that forests on open country receive as much precipitation as free land elevated 200 meters (656 ft.) higher. Further, Prof. Landolt, Zürich, states that for every 100 meters (328 ft.) elevation the annual drainage will increase 10 in.

Between the years of 1843-1883 the Ekaterinoslaw government, Russia, cultivated a forest of 5000 acres, and established two meteorological stations in this section. The reports show that since the introduction of the forest, showers are much more frequent, and the previously feared dry seasons are things of the past. The stations report that the average rainfall between 1893-1897 was 18 in. for free land, while for the forests 22.25 in.

The French government spent 14,500,000 francs between the years 1861 and 1877 to forestize 235,000 acres in mountainous localities. The result was so beneficial that the government decided to forestize about two million acres additional, which will probably cover 60 to 80 years and consume 150,000,000 francs. Austria has at present very elaborate plans to reëstablish forests in denuded sections. The Italian government has set aside $8,000,000 as a beginning toward the reëstablishment of the forests in the southern Alps. For many years Germany has enforced rigid laws for the preservation of her forests, and in recent years has encouraged and assisted water-power developments.

ROBERT FLETCHER.

Thayer School of Civil Engineering,
Hanover, N. H., May 13, 1912.

Lifeboats on Ocean Passenger Steamers a Last Resort for Safety

Sir—The "Titanic" disaster has given rise to widespread discussion on the lack of boat accommodation for all souls on the large passenger liners.

It is not impossible to supply boat accommodation for every person on board; but whether it will be possible to utilize the boats when necessity arises is another question.

I inclose two photographs which I took when I was engineer of the S.S. "California" and which illustrate the difficulty there would be in getting the boats clear in what is a very common state of the weather in the north Atlantic trade.

Again, when a collision is accompanied by a great crash, the people on board would be much more liable to panic than they were on the "Titanic" and the work of getting the boats into the water would be a very serious job.

Unfortunately a number of our maritime disasters have proved that it is a forlorn hope when the lifeboats have to be requisitioned. I favor ample provision for life saving, but I would not feel much safer on shipboard because of the fact that there was lifeboat accommodation for everybody.

All ships will probably now have a sufficient number of boats, but the officers, navigating and engineering, know well that it is "God help us all when it comes to taking to the boats."

There is one thing to note in this terrible disaster. The engineers helped to save the lives of many by their efforts to keep the "Titanic" afloat. When record passages are made, when safe journeys are completed, when accidents to machinery have been successfully repaired, you don't hear much about the part that engineers have played. They generally "make good" and those of the "Titanic" have made a record passage which cannot be forgotten.

W. DICK MACLEAN.

Barna, Arkleston Road, Paisley, Scotland,
May 1, 1912.

Re-Rolled Rails for Concrete Reinforcement

Sir—The degree of surprise expressed by E. W. Stern at being asked for "more detailed" information on the subject of rail steel reinforcing bar cannot, we feel certain, equal that which must be felt by experienced steel manufacturers at some of the remarkable statements contained in Mr. Stern's letter in ENGINEERING NEWS, Apr. 18, 1912, p. 740.

This letter, we presume, relates to the subject of "rail steel" compared to "billet steel" as a raw material for the manufacture of reinforcing bars. It might be summarized as follows:

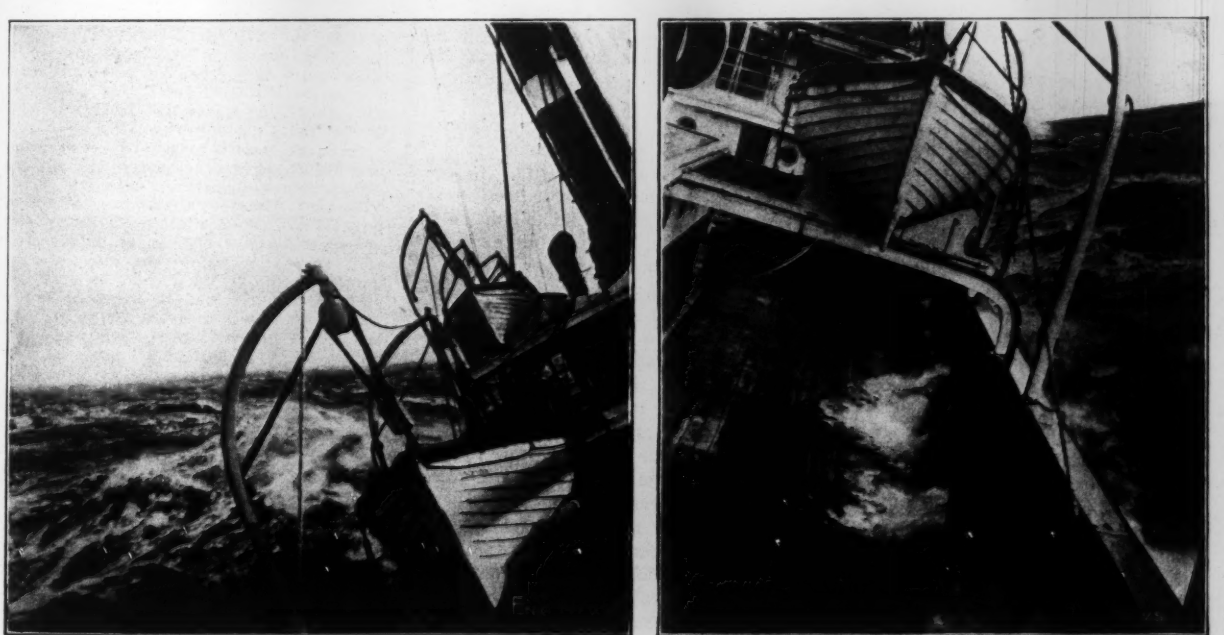
First—That rails compare unfavorably in point of uniformity with billets such as are used in the manufacture of concrete bars.

Second—That rails contain a higher degree of phosphorus than is permissible in any standard specifications for reinforcing steel.

Third—That rails contain from two to three times the percentage of carbon allowed in reinforcing steel.

Fourth—That "segregation" is more marked in rails than in ordinary billets.

Needless to say, we do not agree with Mr. Stern and do not believe that the



TYPICAL ROUGH WEATHER ON THE NORTH ATLANTIC

facts as they exist will bear out his statements.

The word uniformity when applied to steel manufacture is a purely relative term. Actual uniformity does not and cannot exist in steel made in commercial quantities; but we venture the assertion that there can be no comparison between the uniformity of a rail and that of the ordinary commercial billet. Millions of dollars, years of research and continual experimenting have developed the uniformity of the present-day steel rail. All that science could suggest and skill perform has gone into the manufacture of this all-important material with that object in view.

The fact that rails have failed in service is not evidence that rails are not of good quality or that they are not uniform. It is merely corroborative evidence of the terrific service which every rail must undergo continually. It is service which exceeds in severity any requirement imposed on other grades of steel. It is this extraordinary demand made upon the rail which has led to the exhaustive investigation and continual improvement of its quality and its great superiority over other steel. It is the cost of this improved quality which causes rails today to sell far above the price of other steel which is admittedly more difficult and expensive to produce, so far as the mechanical difficulties of rolling are concerned. The increased cost of rails is represented by the superior quality of the raw material and the rigorous specifications and methods of testing of the finished product. How well these specifications are framed, how conscientiously these tests are made, is amply proven by the infinitely small number of defects developed among the countless millions of rails now in use under extraordinarily severe conditions.

On the point of uniformity the rail needs no defense. It may be possible to improve the quality further by a change of the specifications as to chemical and physical properties, but so far as the uniformity of the metal is concerned, it seems that science can do no more to insure that the rail as it is delivered to the railroad is as nearly uniform as steel can be produced.

What of the assertion that rails contain a higher degree of phosphorus than is permissible in standard specifications for reinforcing steel? A review of all the widely accepted specifications on reinforcing material will show that the maximum phosphorus is set at 0.10. A comparison of rail specifications with this chemistry will refute absolutely the statement made by your correspondent.

An investigation of the carbon content of the standard-section railroad rail, such as are invariably used by the rail-steel bar manufacturers, will show conclusively that the carbon content is *not higher but lower* than that used by the manufacturers of hard-grade reinforcing bar rolled from billet stock. These facts are well known to the trade and are open to conclusive proof by anyone who wishes to learn the truth.

Your correspondent dwells upon the possible injurious effect of segregation in a rail when rolled into concrete bars. He leaves the impression in the mind of the reader that segregation is something which is peculiar to the steel rail, whereas, as a matter of fact, segregation is peculiar to no steel, but is found in all, irrespective of the process of manufacture. Furthermore, greater precaution is taken to minimize the effects of segregation in rail steel than in any other billet product. The percentage of discard absolutely required in rail-steel manufacture is in itself more protection than is obtained for any other steel product; and we feel safe in making the assertion that the effects of segregation are less evident in rails than in any other largely used grade of steel. As a matter of fact, segregation is closely related to uniformity, for it is the one which is apt to prevent the other, and the more closely segregation is guarded against, the nearer we approach to the ideal of steel uniformity.

Your correspondent states that rails made today differ greatly in quality from those made a few years ago. This is not the case so far as relates to the elements under discussion. He states that no bending tests are required in rails, merely a drop test. What is a drop test if not a bending test, and what bending test could be as severe as a drop bending test?

Mr. Stern seems exercised as to how the manufacturer shall determine whether the rails are new or old, rejected or seconds. It does not call for a great deal of knowledge to tell a manufacturer whether he is using rails that have been accepted after competent inspection, whether he is using rejected rails or whether he is using seconds. Rejected rails and seconds have not been in service. A blind man could tell the difference between a rail that has been used in service and the other two classes.

In closing we might say that we think Mr. Stern has overlooked entirely the improvement in the quality of the material due to reheating and rerolling the rail into bars. He has placed too much stress upon the rail as a raw material and not enough emphasis upon the quality of the concrete bar produced from this material. Concrete designers are interested in the bar rather than the rail. The results obtained from rail-steel concrete-reinforcing bars have been eminently satisfactory. These bars are sold subject to identically the same tests prescribed for those manufactured from billets, and as a matter of fact, the chemical and physical properties shown by rail-steel reinforcing bars under repeated test, give better results than are obtained in billet roller material. The elastic limit, ultimate strength and percentage of elongation are superior to those shown by the average hard-grade billet stock material. The bending tests required are identical. Rail steel not only meets these tests, but with a margin of leeway superior to billet steel of the hard grade, as unprejudiced engineers can testify from experience.

Rail-steel reinforcing bar needs no defenders. Its many years of successful use have proved that it is an ideal reinforcing material. If there were actual, tangible evidence that it was not suited to the uses of concrete reinforcing, there is no question that those who make other grades of reinforcing would long ago have brought these pertinent proved facts to the attention of the engineering world.

RAIL STEEL BAR MANUFACTURERS ASSOCIATION, BY L. W. BARNETTE.
Franklin, Penn., May 5, 1912.

Notes and Queries

In the article "A Pump for Unscreened Sewage," in our issue of Mar. 14, by a clerical error the device was given as the invention of "Sir R. C. Parsons, of steam-turbine fame." This should have been the Hon. R. C. Parsons (brother of the Hon. Sir C. A. Parsons, the inventor of the reaction-type of steam turbine). In the first paragraph of the article mentioned it was stated that Shone pneumatic ejectors were used to raise the sewage in the low-lying districts of Buenos Aires. It now appears that these districts were drained entirely by a hydraulic pumping system.

The proportion of a floating iceberg above the water line was given as a little over 8% of the total mass, in the article on "The Structure of the Titanic" in our issue of May 9, page 877. This figure is correct for solid ice floating in fresh water, but in sea water the part above the water line is 10% to 11% of the total mass.

Icebergs with a height of between 100 and 200 ft. above the water line are not uncommon, and during the week of the "Titanic" disaster a number of newspapers published sketches or diagrams showing huge icebergs of bulky section extending below the surface to a depth of 1000 ft. or more. As a matter of fact, icebergs having a height of 100 ft. or over owe this height to the existence of one or more peaks or spires, whose height is out of all proportion to their bulk when compared with the main body of the berg. Cases have been reported of icebergs with a much greater height above the surface than their depth beneath.

Mr. Herbert F. Moore, author of the article on "The Strength of Rolled Zinc," published in our issue of May 9, on p. 862, has called our attention to the fact that the last word of that article should be "plasticity" instead of "elasticity." In the bulletin from which our article was abstracted, it was stated correctly "that the zinc possesses a relatively high degree of plasticity."

R. P.—NEWS NOTE

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.
505 Pearl St., New York.

Monadnock Bldg., Chicago.
6 Bouverie Street, London, E. C.
Unter den Linden 71—Berlin, N. W. 7.

CHARLES WHITING BAKER, Editor.

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.00 in Canada.

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings; 36 marks; or 45 francs.

Notice to discontinue should be written to the New York Office in every instance.

Advertising copy should reach New York Office by Thursday of week before date of issue.

Entered at New York Postoffice as mail matter of the second class.

CIRCULATION STATEMENT

During 1911 we printed a total of 931,958 copies.

Of this issue, 19,000.

None sent free regularly, no returns from news companies, no back numbers kept beyond current year.

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Engineering News

A suggestive paper on the regulation of water rates, as practiced by the Wisconsin Railroad Commission, is printed elsewhere in this issue. The Commission has taken a notable step forward in compelling cities as well as water companies to apportion the charges for water used for public purposes and private purposes alike on a scientific basis, taking into account capital charges as well as operating expenses and readiness-to-serve, as well as actual service. By so doing the Commission has set an example that is bound to be followed in other states, and by individual cities on their own initiative where no public utility commission exists:

We have at various times commented in these columns on the remarkable results in fire protection and the elimination of fire losses attained by the Factory Mutual Insurance Companies, of New England, through systematic inspection and the introduction of engincering principles in the protection of manufacturing plants against fire loss.

We have before us the report of the Associated Factory Mutual Companies, of Providence, R. I., of which John R. Freeman is president. These companies, during the last year, carried insurance on about 2800 industrial plants, representing about $768,000,000 of insurance in force. A large proportion of these are textile manufacturing plants, in which the fire risk under ordinary conditions is extraordinarily high, owing to the nature of the industry. In 1911 the total fire losses for the year per $1000 of value insured amounted to 21c. Losses paid on account of damage done by sprinkler leakage were 9c. The total cost of inspection expenses, surveys and fire-protection engineering were 15c. Adding to this the taxes and administration expenses, etc., made the total cost of insurance to the owners of these hazardous properties for the year only 78c. per $1000 of value insured. Even this small amount was reduced by income received from the company's investments in the reserve fund, which it is by law required to carry, making the net cost to the insured only 46c. per $1000 per annum.

Economic Speeds for Motor Trucks

Standard speeds for motor trucks were formally adopted at a recent convention of the National Association of Automobile Manufacturers. These standard speeds, as reported in *The Power Wagon*, of Chicago, are as follows:

Load rating	Miles per hour
½ ton	16
1 ton	15
1½ tons	14
2 tons	13
2½ tons	12
3 tons	11
3½ tons	10½
4 tons	10
4½ tons	9½
5 tons	9
6 tons	8
7 tons	7
8 tons	6
9 tons	5½
10 tons	5

These speeds are very considerably lower than the maximum speeds fixed in the bill introduced in the Massachusetts Legislature by the Massachusetts Highway Commission. This bill set a maximum speed of 15 miles per hour for trucks weighing with load four to six tons.

The journal above referred to, in its issue of May 7 publishes a symposium of truck manufacturers protesting against the standard rates of speed above recited. The superintendent of an express company operating over 100 motor trucks thinks the listed speeds should be increased 10% to 20% because "such an increase in speed would not increase the cost of maintenance sufficiently to offset the increase in performance." A mechanical engineer of one of the largest concerns building motor trucks thinks the question is up to the auditing department, "that is to say, what is the most economical speed at which we can just wear out the truck by fast running, allowing for depreciation and maintenance and providing a sinking fund to renew the truck at the end of its life." Numerous other letters bring out the general opinions of motor-truck makers that all they want of a standard speed limitation for motor trucks is to have the speed so fixed that the truck itself may not have its engine or other machinery injured by overspeeding. *The Power Wagon* prints a list of twelve "essential points to be considered"; but it never mentions at all the relation of the speed of trucks to the wear and tear of the roadway.

It is entirely clear that the excellent gentlemen who are building and selling motor trucks and the other excellent gentlemen who are purchasing them and using them in their business do not give a thought to the question of the damage done to the roadway which the taxpayer pays for and which they wear out by their heavy high-speed trucks. It doubtless has never occurred to any of these gentlemen that there can be no such thing as a determination of the economic speed of motor trucks without taking into consideration the effect of speed on wear and tear of roadway.

What would be thought of a railroad company which permitted its traffic department and motive-power department to get together and decide on what weight of locomotive with what length of rigid wheel base should be permitted to run over the railway without any regard to the condition of the tracks, the capacity of the bridges, and the sharpness of the curvature? A railroad operated under such extraordinary conditions would promptly meet disasters financial and otherwise. Taxpayers of the United States, however, are spending over $1,000,000 a day in constructing and maintaining highways and are, without exception up to date, permitting the rolling stock placed upon these roads to be run at any speed and loaded with any weight.

Wanted—A Chief of Drainage Investigations

We have received from the U. S. Civil Service Commission a circular which opens as follows:

> There is existing a vacancy in the position of Chief of Drainage Investigations in the Office of Experiment Stations, Department of Agriculture, Washington, D. C., at a salary of about $4000 per annum. The Government is endeavoring to find the best man available for this work and has no particular individual in view.
>
> This position offers unusual opportunity for conspicuous service in drainage work. Executive ability of a high order is essential. The posibilities for future development of the work along broad lines constitute an attractive feature.

Most of the readers of ENGINEERING NEWS, we presume, will recall the reason why there is a vacancy in the position of Chief of Drainage Investigations, and also the circumstances under which C. G. Elliott was summarily dismissed from that position in February last, the ostensible reason for his discharge being that he had transgressed a technicality of departmental accounting whereby money appropriated for one year's work was actually expended for work done during the previous year.

We have no doubt that the government is desirous of "finding the best man available for the work"; but most engineers of such experience and standing as would qualify them to fill the position will be apt to consider very seriously Mr. Elliott's unfortunate experience before they apply for the position. The red tape in the government service is bad enough when it operates, as it too frequently does, to hamper the progress of work, to increase its cost to the taxpayers, and to stifle all attempts at originality and progress, but when, in addition to this, red tape is made use of to strangle unfortunate government servants who are tripped by its coils, the occurrence is an object lesson to engineers who have gained such experience and standing that they can earn a living in private engineering work.

We are justified in calling public attention to this condition because it is not only a serious matter for the engineering profession; it is a more serious matter for the public. The government is carrying on an enormous volume of engineering work. In nearly all the departments of the federal government, engineers are being employed in increasing numbers and their employment is a necessity if the public work is to be done efficiently and economically. But it will not be done efficiently and economically unless a high class of engineers are attracted to the government service. It is an unfortunate fact that the general conditions of employment for engineers in government work, the uncertainty of tenure, the annoyances connected with politics, the meager outlook for promotion, all combine to discourage the ablest young men from seeking positions under the government.

Another feature in connection with this announced examination deserves a word of comment here and that is the absurdity of selecting men to fill positions of high responsibility by a civil-service examination. It is announced that the qualifications for the position "will be determined by a board of experts or experienced engineers to be designated by the commission for the purpose"; but the men who would constitute such a board ought to be the very men who would be available for appointment to the position, provided the salaries paid by the government were proportionate to the responsibilities involved. If the government can select engineers to conduct such an examination, it ought to be able to select an engineer to fill the position without an examination.

The Manifold Duties of a British City Engineer

The office of City Engineer in the United States rarely carries with it either the number of duties or the dignity pertaining to the similar office in Great Britain. This fact is brought anew to our attention by examination of the annual report of O. Claude Robson, engineer and surveyor of the Willesden District Council. This "district" is in all but name a city of considerable size. It is included within the area of Greater London.

An examination of Mr. Robson's report shows that he has jurisdiction of street railways, including their construction, maintenance and watering or sprinkling; "slopping" or the collection and final disposal of all sorts of municipal refuse; sewerage and sewage disposal, including the operation of septic tanks and bacteria beds; street lighting to the extent of the general supervision of electric lighting and the actual maintenance of gas lamps, although the details of running the electric-lighting plant are in control of the district electrical engineer and the gas is supplied by a private company; a great variety of duties connected with the opening of new roads and streets at private expense; the public control of private buildings in numerous particulars; operations under the Town Planning Act; the storage and use of petroleum and carbide of calcium; care of public comfort stations, isolation hospitals, cemeteries, mortuaries, various municipal depots, public baths, parks and play grounds; and finally the "fire brigade" or fire department.

Mr. Robson's duties in these various connections are not merely those of a surveyor. In many cases, he is the responsible executive officer in charge; in others he merely has charge of certain phases of construction work. Altogether it will be seen, even from the foregoing brief outline, that his duties and responsibilities are far more numerous and varied than those of the average American city engineer.

It is interesting to note some of Mr. Robson's comments on various phases of his work. Speaking first of the relation of motor traffic to street and road construction and maintenance, he expresses the opinion that heavy public motors have "come to stay, and the engineer must be prepared to provide proper foundation and crust to his carriage ways to sustain this heavy class of traffic." He suggests that it may be necessary to increase the depth of wood blocks for pavements from 5 to 6 in. and that it may be necessary also to make concrete foundations for pavements more than 6 in. in depth.

It would come as a decided shock to the city authorities of this country to read that the life of bonds issued to pay for wood block pavements in Willesden, as fixed by the Local Government Board, is only five years. Mr. Robson calls attention to the fact that wood pavement laid in December, 1903, under such restrictive loans as these has proved durable for a much longer period. He therefore very reasonably recommends that an application be made for permitting loans for longer terms in the future.

As many of our readers know, it is not at all uncommon for American cities to make paving bonds run anywhere from 10 or 15 to 20 or even 50 years, although the paving itself may be worn out and require renewal in ten years or less. State highway loans in some of our commonwealths, as we pointed out in our issue of Sept. 21, 1911, are also being issued to run for the absurdly long period of 50 years, whereas experience indicates that the life of these roads will be not longer than ten years, even if it extends to that. It is high time that our American municipal and state financiers recognized the importance of limiting the life of bond issues to the life of

the public works for which the bonds are to pay.

In one particular Mr. Robson seems to meet with the same difficulties as are encountered by municipal engineers in America. We refer to the disturbance and sometimes ruin of pavements by trenching to gain access to gas, water and sewer pipes or electric and other wires buried in the streets.

In one respect, however, we are not quite so burdened as Mr. Robson. No American city engineer would think of giving the total area of street openings during a fiscal year as "2 ac. 2 rds. 8 pls. 27 yds." What possible advantage there can be in converting square yards of street opening to poles, rods and acres we cannot understand—but this, of course, is a minor matter which we mention merely as an illustration of the truth of "other lands, other ways."

American engineers who are considering the advisability of adopting motor trucks for various sorts of municipal work will be interested in the following sentence from Mr. Robson's report:

> Briefly I am of opinion that motor traction only pays with heavy loads carted over long distances, but not with intermittent work, such as watering, dusting and slopping.

American water-works superintendents would be envious of Mr. Robson should they read in his report the statement that the cost of water used for street sprinkling is charged to the Highway Department at a rate equivalent to 10c. per 1000 U. S. gal. To determine the quantity of water used, meters are attached to the "standposts rented from the Water Board." This state of affairs is perhaps not so surprising when it is understood that the water supply of Willesden is from the Metropolitan Water Board, which supplies not only the municipalities making up the administrative county of London, but also some of the surrounding territory. The principle involved, however, is one that is generally observed in Great Britain; that is, charging each municipal department for services rendered by it to another department. This is a feature of British practice which might well be copied more extensively in the United States.

Sewer ventilation is a subject which seems to require more attention in Great Britain than in America. This is perhaps due to many of our sewerage systems being newer and in better condition than those abroad, and possibly to the much larger percentage of separate sewers here which permits of the extensive use of vitrified pipe in this country. Besides, our larger water consumption and heavier rainfall help keep our sewers clear of organic deposits, the heavier rainfall sometimes assisting even in the case of sanitary sewers.

Mr. Robson states that the sewer-ventilation problem in Willesden is being solved by erecting ventilating shafts at intervals along the public streets or against buildings. By this means, he says, the old surface grids are being eliminated "and the gases, that naturally generate to a certain extent in the best designed sewer, are thereby taken well above the olfactory nerves of the public, and the nuisance thus reduced to a minimum." There are now 326 sewer-ventilation shafts in Willesden, mostly "at least 30 ft. high."

Such sewer-ventilating shafts are very rare indeed in the United States, if any considerable number exist. We could not name offhand any American city which makes use of ventilation shafts of this kind.

Operation of the sewage-disposal works of Willesden seems to be accompanied by some difficulties. The open septic tanks, Mr. Robson states, are "situated unfortunately near to inhabitated dwellings, to which they were undoubtedly most undesirable neighbors, as the effluent therefrom after septic treatment is naturally somewhat of an odorous character." Apparently, the taxpayers of Willesden can afford to put up with something in the way of odors from septic tanks in view of Mr. Robson's statement that since their adoption there has been a saving in the cost of chemicals used in the old chemical precipitation plant, and through the entire omission of sludge pressing, amounting in all to nearly $15,000 a year.

There is still a sludge problem at Willesden, however. The sludge and grit deposits from the grit chambers are being added to the sludge dumps on the farms, which have a total volume of about 25,000 cu.yd. Attempts to induce farmers to utilize this sludge for fertilizing purposes have been the means of getting rid of only 1090 long tons, the farmers paying transportation charges.

"Certain patentees with sanguine expectations," Mr. Robson states, have held out what have proved to be vain hopes of utilizing the sludge, but they have found a material difference between the results of laboratory experiments and tackling such a great heap of sludge in the field.

It may be added that sewage-treatment difficulties at Willesden will soon be over, since arrangements have been made for connecting with the main drainage works of the London County Council. A portion, at least, of the local disposal works will be retained for the treatment of the excess of storm flow above the stipulated discharge into the London main sewers.

The small number of fires in Willesden in the year 1910-11, makes one almost wonder what the Fire Brigade, as the Fire Department there is called, does for exercise—unless indeed the Fire Department is proportionately small to the number of fires. The total number of fire alarms for the year was only 91 and this was for a population of 155,243. Moreover, 47, or more than half of these alarms required no action on the part of the Fire Department so far as fire extinction was concerned, 6 calls were false alarms, and only 6 of the 91 calls were for what is classed as serious fires. The small number of fires in 1910-11 was not unusual, although there has been a gradual decrease for some years past. Expressed in percentage of calls to the total number of "houses" there was a decline from 1.517 in 1890-91 to 0.389 in 1910-11. We have no strictly comparable American figures at hand, but it seems safe to say that few American cities of like size could make anything like so good a showing.

The report, as a whole, while an interesting review of the year's activities of a British municipal engineer, contains surprisingly few specific data which throw light on the efficiency of the work carried out under his direction. Perhaps this is in considerable part explained by the fact that owing to the recent establishment of an accounting department for the whole municipality, this particular report does not contain the financial tables usually given. It seems unlikely, however, that any tables prepared by an accountant would present the unit-cost data which are essential to judge the efficiency of a great engineering department. The reports of our American city engineers are often deficient in just such statistics as we have indicated; but, as a rule, the reports of our larger cities, we think, contain more unit-cost data than are given in this report. It may be that unit-cost and other efficiency data are given more fully in the other Willesden departmental reports.

What Is the Remedy for Mississippi Floods?

[In printing this editorial in our last week's issue, an error was made in the printing office, which must have very seriously confused those of our subscribers who attempted to read the article. They must have thought either the editor or they themselves had become "puzzle-witted," for the second and third galleys of the article became transposed and only a reader with a sixth sense could have found his way through. The subject discussed is one on which it so important at the present time that the engineering profession should have clear ideas, that we reprint the editorial below arranged in correct order. We advise our readers who bind their volumes to cross out the article in the last issue and insert a reference to this page on which it is correctly printed.—Ed.]

There is no doubt that the flood now prevailing in the lower Mississippi Valley far exceeds in destruction any floods of that river hitherto recorded. This is not because the volume of water now passing down the channel of the great

river is larger than that of any previous year. In fact it is likely that the present flood flow is a little less than that which was recorded in the great flood of 1897.

It is 15 years since the lower Mississippi Valley has suffered from a flood. During that period a vast amount of development has taken place in that fertile region. Under the protection of the levees, which have year by year been enlarged and made stronger, farms and plantations have been improved, land formerly worthless has been brought under cultivation, sawmills and sugar mills and cotton gins have been built, towns and villages have sprung up, a vast amount of money has been spent in buildings and improvements. The great damage wrought by the flood of this year, therefore, is largely due to the fact that there is a greater population and a larger amount of wealth to be affected by the flood.

Without doubt the disastrous experiences of the present year will bring forward anew for discussion the question what can be done to hold within bounds the lower Mississippi. There will be probably a renewal of the old attacks upon the levee system, and a new crop of proposals for various substitutes will be brought forward, each guaranteed by its inventor to accomplish the impossible. To those of our readers who are interested in this subject and desire to give it some study we can give no better advice than to refer them to the admirable monograph on Mississippi River Floods by the late William Starling, published just after the great flood of 1897.

We believe that in securing the publication of this paper by Mr. Starling, first in our own columns and later in separate form, we performed a valuable service to the engineering profession and to the public. Mr. Starling's paper has since been officially recognized by committees of Congress which have investigated the subject of Mississippi River floods as the highest authority upon the subject.

Doubtless the chief argument which will be brought forward by the opponents of the levee system will be the fact that the levees have this year failed to protect the valley from floods. The answer to this criticism is that the levees have failed because they were neither high enough nor strong enough for the work they were called upon to do.

It should be understood that in the building of the Mississippi River levees up to the present time, the problem put up to the engineers has not been: "What levee will you build to safeguard the country behind it and what will be its cost?" The engineer has been given a certain sum of money to be expended in a given district and has been told to make it go as far as possible in levee construction. Every engineer knows what is likely to happen if he is told that he can have a certain amount of money to build a dam with and to build the best dam he can with that sum. If the amount allotted is insufficient for thorough engineering and construction, the dam is likely to fail at the first high-water season. Hardly a month passes, in fact, that such failures are not brought to our notice.

The levees which confine the flood waters of the Mississippi are practically long earth dams. The main levees are now high enough and strong enough to hold the river within bounds in any ordinary season. For 15 years past there has been no serious overflow or breakage of the levees, but the experience of the present year demonstrates that the levees are far from being high enough or strong enough to confine such a flood as came down the river in 1897, or as is now flowing down the channel.

As has been frequently explained in these columns, the flood height on the Mississippi depends not alone on the volume of the flood's flow, but on the extent to which the river is confined between the levees. It makes a great difference, of course, whether this whole broad alluvial valley, 30 to 60 miles in width, is flooded or whether the flow is confined between the river's banks, topped by levees two or three miles apart. This is the first great flood in which the whole lower Mississippi has been confined between levees. In the flood of 1897, the great St. Francis basin in Missouri, some 6000 sq.miles in extent, was only partially inclosed by levees and at least 2000 sq.miles of it were flooded at the start by the high water spreading over the unleveed banks. A little later crevasses occurred in front of parts of the basin protected by levees so that the flood extended over nearly the whole basin. There were also numerous breaks in the levees protecting river basins farther down the main stream.

The loss of water from the main channel through these crevasses so affected the flood heights that the river gage records of 1897 are only a general indication as to what heights would have been reached by the flood volume of that year were the river entirely confined.

The conditions of 1897 have been substantially repeated this year. While the whole river is now inclosed by levees, the water has escaped by over-topping the levees and through crevasses, so that the flood heights reached this year, while exceeding any ever recorded, are still far below what would be attained if all the levees had held. If, then, the problem were put up to engineers as to what height of levee would be required to hold safely the greatest flood on record, *or possible*, it is probable that the present levee height would have to be raised 10 to 15 ft., or in some cases even more.

There is nothing impossible in such a raising of the levees. It is perfectly practicable to do the work if money enough is provided; nor would the expenditure be so enormous as might be thought. Some 13 years ago the late Captain Waterman, Secretary of the Mississippi River Commission, estimated that the entire levee system on the whole Mississippi River built up to that time contained 165,000,000 cu.yd. of earth and had cost a total of $47,600,000 in round numbers. He estimated that an additional expenditure of $20,000,000 would complete the entire levee system from the head of the St. Francis basin to the outlet into the Gulf and make it sufficiently high and strong to give protection against the highest recorded flood.

It is probable in view of the present year's experience in flood heights that this latter estimate is inadequate and that a considerably larger sum would be required. Even so, the great increase in land values and property values in the lower Mississippi Valley in the last 15 years makes an expenditure on its protection possible and worth while which would have been out of the question 15 years ago.

It may perhaps be argued that if such great floods as the one of the present year, or the one of 1897, were to come at no more frequent intervals than 15 years, it would be cheaper to endure the loss and inconvenience of these occasional devastations rather than spend the money a complete levee system would cost. It would be practicable, for instance, to protect the principal cities exposed to floods, such as Memphis and New Orleans, by levees so high and wide that no possible flood could over-top them. This, in fact, ought to be done in any event. As we pointed out at the outset of this article, however, towns and cities and manufacturing industries are growing up all through the delta region subject to overflow, and the lives and property at stake certainly justify the expenditure sufficient to give complete protection from floods.

The question who should bear the burden of paying for these levees is a knotty one. The present levee system has been built partly by the property owners themselves, partly from the proceeds of taxes levied on the entire area protected from overflow, partly from direct state taxation and partly from federal appropriations. Of the total amount of levee work done up to 1899, over three-eighths had been done by the federal government at a cost of about $13,300,000. This was less than a third of the total amount expended for levee construction. It should be understood, however, that all the money spent on levee construction by the federal government is spent under the pleasant fiction—we can call it nothing else—that the work is for the benefit of navigation. Under the same pleasant fiction that it is doing

something to improve navigation, the government has been for 15 years past spending $1,000,000 to $2,000,000 a year in dredging channels across the bars during the season of low water, for the benefit of a river traffic which has practically disappeared. Of course, all this dredging work on the river bottom at low water is wiped out at every high-water season and has to be done over again. If all the millions of dollars which have been spent on this dredging work in the low-water season during the last 15 years had been expended for building levees, it is reasonable to believe that at least two-thirds of the lives and property lost in this year's great flood might have been saved.

It does not seem necessary, either, that the pleasant fiction that levee building is an aid to navigation needs to be kept up in order to justify the expenditure of money by the federal government. We have frequently urged in these columns the proposition that river regulation on interstate streams is a field for federal rather than state action. While it is theoretically possible by interstate compact to carry out such work under direction of the several states, the difficulties of making and carrying out such compacts are so great that they must be recognized to be practically impossible. The Mississippi, for example, is an outlet channel for rivers flowing from more than twenty different states. It is not unjust that all these different states should bear some part, at least, of the cost of controlling the floods which they send down to the lower river.

No doubt the chief cost of the levees along the lower river ought to be contributed by the owners of the property protected. The increase in land values which has already taken place, with the increase in the value of farm products, makes it practicable to place assessments for levee work on the land owners at a rate which would have been out of the question 20 years ago.

We alluded above to the probability that the present year's flood would bring forward a new crop of proposals for improving the levee system. The crop, in fact, is already here. *The Review of Reviews*, for May, has an article entitled, "How to Remedy the Mississippi River Flood," written by P. S. Yoakum, Chairman of the St. Louis & San Francisco R.R. Co. Mr. Yoakum's proposition, briefly stated, is that the Panama Canal plant and organization should be transferred to the Mississippi Valley, since "it is now rapidly becoming idle and is especially adapted for dredging and constructing levees." In a letter to George H. Maxwell, Chairman of the National Drainage Congress, held last month at New Orleans, Mr. Yoakum says, "You understand better than others that opening streams and the removing of obstructions to permit the free flow of large volumes of water greatly relieves the pressure against the levees."

It is a pity that a man of Mr. Yoakum's prominence in the business world should lend the weight of his authority to such misleading ideas. The government has been dredging in the Mississippi River channel during the low-water season for 15 years, and has expended many millions of money in the work, but it has had, of course, absolutely no effect on flood heights. As for using the Panama Canal plant to build levees along the Mississippi River, it would probably be the most expensive levee construction ever attempted in that valley. The Panama Canal plant was well chosen to do its especial work. There is very little of it, indeed, that would be economically adaptable to the conditions prevailing in Mississippi levee construction. The value of the Panama Canal plant at the present time is very much over-rated in the popular mind, anyway. During the years of hard work which the equipment down there has been through, much of the machinery has about reached its limit of economical life. Every manufacturer understands that when a machine in his shop reaches such a state of general wear that breakdowns are frequent and the maintenance bill is heavy, it is more economical to send the machine to the scrap heap and buy a new one than to attempt to get along with the old. Exactly the same thing is true of excavating machinery.

Another question which is doubtless destined to receive more or less discussion is whether some better construction than an earth embankment can be adopted for the Mississippi levees. Concerning these popular solutions of the Mississippi problem, Major Starling, in ENGINEERING NEWS, 15 years ago, said:

> During and after each high-water season, especially if it be attended by signal disaster, the newspapers teem with articles on the Mississippi problem. As a general rule, these productions are distinguished not so much for lack of ability as for lack of knowledge. Usually the writers have not taken the trouble to inform themselves upon the most elementary facts and principles involved in the discussion. Iron levees are proposed, wooden levees, stone levees, cement levees, brick levees, glass levees, paper levees. Each man takes up the subject for the first time, evidently supposing that nobody has thought about it except himself.

Concerning all these proposals, Major Starling said:

> Sound earth is a good enough material for levees without iron, brick, concrete, wood, paper or glass; but the bank must be carefully built, of sufficient dimensions and especially in case of a light or treacherous underground must have its base extended by a banquette. As to the cost, it may be briefly said that levees are the least expensive means of reclaiming overflowed lands that have ever been proposed.

What Major Starling wrote 15 years ago is true today. There is no reason to believe that any other kind of retaining wall than a plain earth embankment would be more safe and satisfactory to confine the flood waters of the lower Mississippi. As every engineer knows, levee building is a problem of dam construction, and while dams of masonry or concrete are chosen by engineers where rock foundations are available, the problem of building a dam on soft ground porous foundations has never been solved by engineers in any better way than by the construction of earth embankments. This is true not only of the levees in the lower Mississippi Valley but of the levees on every other alluvial stream the world over, and of the dams which have been built on alluvial formations in India, Panama, Mexico, United States and other countries. The famous dikes which protect Holland from the sea are earth embankments.

We are aware that there is a very general impression that an earth dam is a cheap, unreliable structure; but this impression is largely due to the fact that earth dams are by many supposed to require no engineering knowledge to construct. Their building is, therefore, entrusted to whatever contractor will offer to do the work for the lowest price, and a heap of dirt is piled up with little knowledge or judgment. So many dams are built in this haphazard way that the wonder is not that dam failures are so many, but that they are so few.

What is true of earth dams is true to a great or less extent of the earth levees along the Mississippi River. While the work done during the last 20 years and especially that during the last 10 years, has been generally under the charge of engineers, there are still incorporated in the levee line more or less stretches of old levees built with little care as to foundations or material. There are in the levee line stretches which have settled so that their summits are below grade. There are sections where wood and stumps have been buried in levees to afterward decay and cause interior hollows. It ought to be clearly understood, therefore, that the over-topping and breaking of levees in the present year's flood is no argument against the levee system or against the soundness and safety of properly designed and built levees. Neither is it any argument against the competency of the engineers engaged on levee work or their wisdom and judgment in building earth levees.

Since the above was written the crest of the Mississippi flood has passed New Orleans and while high water in the upper Mississippi and Missouri will probably keep the inundated lands along the lower river covered with water for several weeks yet, no further serious damage to the towns and cities in the delta district need be apprehended.

Report on the Sanitary Efficiency of the Philadelphia Water Works

A preliminary survey of the sanitary and public-health phases of the operation of the water supply of Philadelphia has been conducted by an outside sanitarian for the benefit of the reform administration. Various lines of improvement in sample collecting, over-inspection, general operating control and higher sanitary efficiency are recommended, as also are measures to cut down the enormous water consumption and waste for which Philadelphia has long been notorious.

As a means of posting himself on the efficiency and needs of the various branches of the municipal service under his control, Morris L. Cooke, the recently appointed director of the Department of Public Works of Philadelphia, is having various preliminary investigations or surveys made. A report on such a survey, following questions submitted by Mr. Cooke, was made under date of Mar. 19, 1912, by Hollis Godfrey. Mr. Cooke's questions were as follows:

(1) Are our methods of securing samples of water such as to make it possible for us to know the condition of the water?
(2) Are our examinations conducted frequently enough, and do we obtain our results as promptly as we might?
(3) Are the standards of neatness and accuracy sufficiently well established to command respect?
(4) Most important of all, are we going around in circles, or are we really accomplishing what we set out to accomplish? As you know, in industrial establishments this is a frequent occurrence, and I am led to believe that in the city service we defeat our ends more often than we accomplish things.
(5) What type of "over inspections" should we have? Are the analyses of the water carried on by an agency sufficiently separate from the manufacturing? Should we not provide for a periodical examination by an agency perhaps absolutely distinct from the department? What steps can be taken toward getting greater publicity of the results of our water analyses?
(6) Do you consider our policy in regard to water treatment uniform and consistent? What changes would you recommend?
(7) Perhaps the most specific object of the investigation which I am asking you to make is: What further inquiry would you suggest looking toward putting our water service on the most enlightened basis?

Mr. Godfrey states that in his report he "deals with the problem of the Water Bureau of Philadelphia as an industrial plant selling its product, water, to the consumer, who is its customer." Before going into details Mr. Godfrey summarizes his conclusions, as follows:

(1) The appointment of a sanitary engineer who shall have general charge of all problems concerning the quality of the water, reporting directly to the chief.
The preparation of instruction cards embodying the best methods and mechanism of control of quality to be furnished the collectors.
The making of over-examinations.
(2) New methods of plant control by means of telephonic reports and summaries of general reports by which unusual conditions may be met at the first moment possible. The introduction of original recording by graphical means.
(3) (a) The determination of a policy as regards raw water with a view to the prevention of raw water being served to the consumer.
The building of an alternate pipe at Upper Roxburghe to guard against raw water being served Germantown in case of a break in the mains.
(b) The improvement of the healthfulness of the water by the establishment of permanent hypochlorite plants which have been proved of great benefit.
(c) Repeal of the ordinance forbidding the use of meters.
(4) Beginning of a series of thorough studies to find out the best and cheapest way to do away with all turbidity or muddy water and to generally improve the system.
The beginning of a definite campaign of publicity.

Dealing with Mr. Cooke's seven questions in their order, Mr. Godfrey first points out that the present practice of taking water samples from the Delaware River at the same time each morning gives misleading results as to the character of the raw water treated at the large Torresdale filtration plant, since the pollution of the river varies with the state of the tide. He says:

It is the daily state of highest pollution of the river which is important to the customer. It is not practical to delay taking the samples until midtide each day because of the fact that the management requirements of the plant make it necessary for the information to come in at the same time each day and as early as possible. It would be well, therefore, to begin at once a study of the relation between bacterial content at the time of collection and at time of highest pollution, including variations not only of tides, but of seasonal conditions such as flood, the effect of tide being determined for different heights of the river. Two approximate coefficients are possible: height of river and state of tide. Such a study would at least show the general relation between pollution and state of water, and would make it possible to interpret the routine more intelligently.

A sample-collecting case is recommended for protecting samples from extremes of heat and cold. It appears that the contents of unprotected sample bottles froze during the past winter, thus causing loss of bottles by breakage and loss of time for melting ice; or, if the ice were not melted, the water encased by ice was not representative, owing to the well known concentration of impurities in the water.

Answering Questions 2 and 3, the report states that samples are now collected with sufficient frequency, but over-inspections are needed as checks; also that the general standards of neatness and accuracy in the laboratory are good.

The reply to Question 4, "are we going around in circles, or are we really accomplishing what we set out to do," is one of the most suggestive portions of the report. Omitting statements of fact or principle familiar to all who have paid much attention to the control of filter plants, we quote Mr. Godfrey's answer to this question, as follows:

(a) The answer to this question involves the whole problem of the management of a water bureau. It can only be answered in so brief an examination as this by reference to single lines of management. I have chosen as the single line to be considered here, the subject of the control of the plant through reports.

The reports now in use violate every part of the "exception principle"; that is to say, they present a mass of figures most of which are wholly regular and, therefore, unimportant as a guide to future action. The exceptional conditions which need special attention are hidden in a mass of other figures with no attempt at selection. The control of a water plant, like any other industrial plant, depends first upon keeping up the quantity and quality of the product. And the reports turned in should give the essential facts concerning quality and quantity in such a way that they may be immediately usable and be unobscured by masses of detail.

It is of no practical advantage to the management to read the records of 20 filters which ran 24 hours with a normal output. It is of importance to the management to have the report of all filters newly started on a run in order that the new conditions of the filter service may be known and for them to know every case where anything affecting quantity or quality of service happens to a filter. All the facts needed for general information of quantity and quality and for special information concerning the operation of specific parts of the plant should be in the management's hands at the first possible moment each day. At present this information is uncodified, telephoned in at odd times in the morning when a party line happens to be free and entered on scratch paper.

Through the assistance of Mr. Van Loan a tentative record of those facts which it is essential for the management to know has been made up, and it is proposed that instructions be issued to each reporting office to telephone in at a definite time, this time being the earliest time possible. To secure accuracy of transmission, a most important point, it is proposed to have two clerks take the report individually, one directly after another, and then compare results.

Such reports should come in in two parts, one from each superintendent and one from each chemist in charge. The report from the superintendent of each plant should cover the period ending with the preceding midnight and should give the quantity filtered at each plant, the number and condition of each filter newly started during the 24 hours reported upon, any unusual changes in conditions of operation, the elevation of sedimentation and filtered water basins. From each river one report should be sent in of the river's elevation.

The report from the chemists should give the turbidity for the present day and the bacterial count and the color report for the next day but one before. It should particularly contain any abnormal bacteriological results indicating

that any part of the process is not doing its work efficiently.

(c) Formal written reports showing the regular inspection and working of the plants must supplement the telephone reports, but such reports should not go to the chief or his assistants. It should be the function of the subordinate in charge of such reports, who may be called the filing clerk, to compare the telephonic records previously received with the written reports which follow and to note and report any discrepancies. General instructions for the summarizing of the data of the written reports should be made out and the weekly summary prepared on the basis of these instructions should be submitted to the chief and his assistant. If a sanitary engineer, as recommended, is appointed, this engineer should also receive the summary.

Such weekly reports should give all necessary averages to show the efficiency and cost of each part of the plant for the week reported upon. Monthly comparisons of the efficiency and cost of running the plant the corresponding month for the two preceding years should be made. These reports of comparative cost should be made monthly instead of weekly, because floods and similar disturbances can be better compared in months than in weeks. It is most important that the seasonal relations which effect the water should be constantly before the management. It should be particularly noted here that summaries of the important matters and only summaries should be submitted to those in charge of the management. Each unnecessary detail which gets through to those in charge takes time needed for necessary matters.

I recommend strongly that all original records made through the plant be changed wherever possible from numerical to graphical form. A row of figures like the following:

24—24—24—24—26—24—24—24—24—24

calls little attention to the variation from 24 to 26. A graph [showing the same facts—Ed.] calls attention to the variation.

(e) Reports of this type are far easier for superintendent and inspectors to read at a glance. They are no harder for the workmen to make and I have never in my experience found a workman who could not be taught easily to use the graphical method of record.

(f) It should be noted carefully in this case that I recommend that the original record be made in graphical form and not that a graph be made from the numerical report. Transcriptions of this type is waste of clerical labor.

(g) One more point should be brought up in this connection: the graphical reports should be made upon ordinary cross-section or coördinate paper, with a section for each 24 hours in most cases and with 31 of these 24-hour sections arranged on a double roll, such as is used by grocers for charge slips. By this contrivance the section for the day desired may be rolled into place from the unused roll at the beginning of each day's record, and the inspector at any time during the month has the whole month's record with its variations at his hand on the used roll. At the end of the month the rolls should be sent into the record office for examination, summarization and final filing.

(h) In connection with these reports I should recommend that a daily report of the typhoid cases in the city with as much history as can be obtained, should be obtained from the Board of Health by the Water Bureau and be compared by the inspector recommended and by others in authority, with the water conditions which existed at the probable beginning of the period of incubation of the disease. Such reports are now turned in weekly with the home address. They should be turned in daily and should give both home and business address. In a city with so many distinct filtration plants this last point is important.

In answer to Question 5, Mr. Godfrey first states that the over-inspector of the purification works should "have training as an engineer, a bacteriologist, and an epidemiologist." Continuing:

He should be an engineer rather than a medical man, for it is as engineer and bacteriologist that he must be able to recognize the relation between the running of the plant and the tests of the product. And as epidemiologist he must recognize the relation of the water to disease in the city. This training is possessed by the sanitary engineer, and I recommend that an inspector with the training of a sanitary engineer be appointed, who shall be responsible to the Chief of the Water Bureau alone. I believe an employee of the Bureau can obtain far more coöperation in the carrying out of his work than an outside agency can obtain, but I feel that such an inspector should be responsible to the Chief alone. One of the present assistants of the Chief has the duty of inspection as a part of his work, but I believe his direct work of production, of quantity, of cost and of general running of the plant is quite as large a burden as he should carry. I therefore recommend the appointment of an inspector who shall have full charge of the quality of the water, acting under the orders of the Chief and in coöperation with the present assistants. A list of the functions of inspection made from a study of this plant and of the best practice of other plants, should be made up for the guidance of this official by some competent body. A body to make such a list of functions could well be composed of the Director of Public Works, the Chief of the Water Bureau, and a Sanitary Engineer.

Coöperation between the Water Bureau and the University of Pennsylvania is suggested, in the way of monthly check-analyses and friendly advice by the latter.

In attempting general publicity, "technical facts concerning water" should be expressed in "the every-day language of the consumer." Publicity members should first be approved by medical and scientific societies, then newspaper coöperation should be sought. Later, a "publicity man" might perhaps be engaged "to carry out a definite publicity plan." The special need for publicity at Philadelphia is well put in the report, as follows:

In the case of the water of Philadelphia you have a plant manufacturing a product whose quality is still questioned by a very considerable number of its customers and whose product is being wasted in such a way as to force it to incur large needless expense, this waste also operating against the keeping up of any adequate reserve stock.

As regards the fact that the quality of Philadelphia water is being questioned, I beg to call attention to two facts which came under my notice in the past week: (1) All students at Bryn Mawr are instructed to drink no city water in Philadelphia; and (2) that many times in the last 12 months the authorities have been compelled to advise the consumers to boil the water.

As to the wastefulness of the water, I beg to call attention to Hazen's table of comparative per capita use in different cities showing Philadelphia near the top of the list with over 200 gal. use per capita per day for the last three years and a group of cities with less than half that consumption making approximately half the list. One hundred gallons use per capita per day is quite as high a figure as most sanitarians of my acquaintance feel is in any way necessary. Philadelphia's daily use of water is so great and so wasteful that it would take but a comparatively small saving per capita of waste water to pay for all inspection and publicity expenses. Each gain in public confidence in the water supply has a real value in the support it brings to the management of the water plant.

Question 6, as to a uniform and consistent policy of water treatment, brought out, first of all, a recommendation for a duplicate supply-main between Upper Roxburgh reservoir and Germantown, in order to avert a repetition of an experience which occurred in the latter part of 1911, when for seven days raw water was sent into Germantown during the repair of a serious break in the single supply main to that section. That notices to boil water at such times are only a partial safeguard is proved by the fact that notwithstanding such notices an epidemic followed this instance of a supply of untreated water to Germantown.

Mr. Godfrey states that there "is only one other plant at which raw water can enter the mains—a now disused gate in the sedimentation basin at Queen Lane." He advises that this gate be either permanently blocked off, or else a dry chamber constructed. In the case of any possible raw-water connection being maintained to meet fire-protection emergencies, Mr. Godfrey advises double gates, with a dry chamber between; the gates to be sealed and locked, the keys and the right to break the seal to be under the sole control of the Director of Public Works.

A careful study should be made to determine whether all raw-water connections should be abolished or the practice just noted should be adopted. If the conclusion should be for the latter, then at every such pair of double gates and dry chamber provision should be made for treating the raw water with hypochlorite whenever it is used.

Permanent hypochlorite plants are recommended at each of the filtered-water basins. Temporary hypochlorite plants exist at Torresdale, Queen Lane and Upper Roxburgh, but according to Mr. Godfrey these are crude affairs, not under proper mechanical or bacterial control. Daily bacterial counts of water from the Torresdale filter basin, Feb. 22 to 29, 1912, showed a range of from 230 to 2100 bacteria, with positive colon tests for a 1-c.c. sample on one day and positive tests with 10 c.c. on 7 of the 8 days. The conditions were "unusual," but it is unusual conditions that must be met.

Since the cost of cleaning the final filters "increases progressively with the load placed upon them of matter which passes through the pre-filters," efforts to increase the efficiency of the latter should be made. It also seems desirable to study the use of a series of screens before pre-filtration, "especially in view of

the work already done along this line in the sewage experimental station of Philadelphia.

The repeal of the present city ordinance forbidding the use of meters in Philadelphia is recommended, together with studies of water consumption and waste. Included in the latter should be a study of pipe leakages. On this point Mr. Godfrey says:

> One study which should be begun at once is the study of leakage in pipes. All the data collected in the last few years point to the conclusion that the losses here are very considerable. This is a matter which the Department should correct by systematic investigation, as has recently been done with success in New York. In this connection I beg to call attention to the article in the Engineering News of Mar. 14, 1912, page 480, submitted with this report.

The answer to Question 7 is largely a repetition, in summarized form, of portions of what has gone before.

A notable final recommendation made by Mr. Godfrey is that after further "internal studies" of the water-works and a "trial of the primary recommendations" embodied in his own report, "a second investigation" be made "by another sanitary engineer for the purpose of laying down in detail the lines of the different investigations recommended in this report."

Dam Building and Bullet Dodging in Mexico

By William B. Fuller*

As rumors have just reached here (May 1, 1912) that work is stopped at La Boquilla Dam, the writer desires to correct any such impression and to state that a full force is working night and day, and to present an idea of the largest construction project in this part of the world and what is being done upon it.

La Boquilla Dam, across the Rio Conchos, in the State of Chihuahua, Mexico, is to be one of the large masonry dams of the world, 79.5 meters (261 ft.) high from the bottom of the heel trench to the top of parapet, and retaining 69.5 meters (228 ft.) depth of water. Its top width will be 5.86 meters (19 ft.) and the bottom width of the maximum section will be 61.15 meters (200 ft.) at low-water elevation. The dam is curved convex upstream to a radius of 264 meters (866 ft.) and its top length is 256 meters (840 ft). The maximum section extends lengthways across the stream for about 110 meters (361 ft). The dam will contain about 300,000 cu.meters (390,000 cu.yd.) of masonry. The reservoir formed by this dam will have a capacity of about 2,800,000,000 cu.meters (about 740 billion gallons) and will flood an area of 150 sq.kilometers (58 sq.mi.).

Work on the foundation of the dam was started in the fall of 1910, but owing to failures of coffer-dams and to difficulties in building them to withstand the heavy floods, no masonry was laid until March, 1911. The coffer-dams were again destroyed by flood after only a small amount of concrete had been placed and before the deeper part of the excavation had been made. On top of this damage came the first revolution and work was entirely stopped for several months and masonry work was not again started until November, 1911, since which time work has steadily continued and the masonry is now well above all ordinary heavy flood elevations.

The foundations to a level above ordinary high water are built of concrete made from portland cement, a very well graded river sand, and graded gravel or graded crushed limestone of a maximum diameter of 4 in., all mixed in Smith mixers in the proportions of 1:1¼:6¼. Concrete instead of cyclopean masonry was used in the foundations, as it was easier to handle, did not require an extensive plant and could thus be started without delay and secure results while the permanent plant was being installed, speed being an essence of the undertaking. This turned out to be a very fortunate choice, as the second revolution, still in progress, has greatly delayed the completion of our permanent plant, but has not materially stopped our progress.

It is the intention to build the bulk of the dam with cyclopean masonry similar to that first used at the Boonton Dam in New Jersey, using blocks of limestone up to 10 tons in weight, set in portland cement concrete mixed in the proportions 1:2¼:7¾. Four rapid Lidgerwood cableways and eight derricks are partly installed for this work. The cableways are to place concrete during the day and furnish stone to the derricks at night. The derricks will place the stone in the concrete during the day. All power used on the work is electric and all transportation is by electric locomotives.

A subsidiary dam in addition to the main dam above described is being built to prevent overflow at a low gap between two hills about a kilometer (0.6 mile) from the main dam. This dam is to be 795 meters (2610 ft.) long, and at its maximum section will be 33 meters (108 ft.) high from the bottom of the heel trench to the top of parapet and retains 22 meters (72 ft.) of depth of water. An earth embankment will be placed against the downstream face. The masonry portion is now half finished and consists of one-man limestone blocks laid in a hydraulic lime mortar made at the site of the work from burnt clay and burnt limestone. The proportions of the mortar are one part powdered burnt clay, one part powdered lime and three parts sand. This character of masonry is rather new on this continent, but is particularly well adapted to the labor and political conditions of Mexico and its value will be enlarged upon in another communica

About four kilometers (2.5 miles) the main dam a spillway one kilom (3280 ft.) long will be built at ano low gap between two hills, but no w except preliminary borings has as been started at this place.

The political conditions of this cou have added greatly to the troubles engineering and construction. In M 1911, the camp was occupied by the then rebel forces and the man who was at that time superintendent of construction for the contractors came very near being lined up in front of a firing squad for having brought in and concealed enough rifles to arm the men in camp. Later the work was practically abandoned and not started up again until peace was restored, when the rebels of that time became the Federals of today. On Feb. 1, 1912, another insurrection broke out against the present Federals and this party, known as Liberals, has so far gained full ascendency in this state. The transition from Federal to Liberal authority has, however, caused a continual state of worry on account of the upsetting of all methods of communication to such an extent as to have practically cut off all news from the rest of the world and prevented obtaining any supplies for the last three months, and the end is not yet in sight. Fortunately, in anticipation of trouble, heavy supplies have been laid in of most of the necessary articles, such as cement, dynamite, coal and food, enabling construction to be continued at full speed with the intention of completing the work by July, 1913.

The Federals were in control here until Mar. 15, 1912, when a battle occurred right in camp between the Liberal and Federal forces. The drafting office, dining room and kitchen were used as forts during various stages of the battle and the window panes, doors and walls are now beautifully studded with bullet holes. One man, mortally wounded, was found in the kitchen, two were killed under the sand screen and several were found strewn around in the railroad yard. While taking the wounded man to the camp hospital, nine of the "gringoes," including the general superintendent for the contractors and also the writer, were trapped between the fire of both forces in a small adobe house used as a laboratory and were under incessant rifle fire for two hours. The battle lasted seven hours, during which time probably 40,000 shots were fired, 12 persons killed and about 25 wounded. Two days afterward the work was going on as if nothing had happened.

T. L. Bouston is general superintendent and agent for the contractors, S. Pearson & Sons, of Montreal, Canada, who are doing the construction work on a percentage basis for the Mexican Northern Power Co., are represented

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here locally by the Compañie Agricola. Shirley C. Hulse is assistant engineer in charge of construction of the La Boquilla Dam. Messrs. John R. Freeman, Frederick P. Stearns and Isham Randolph have been connected with this work as consulting engineers, reporting on general features of the power development and construction work. The writer is chief engineer.

Annual Convention of the National Fire Protection Association

The 16th annual convention was held at Chicago, May 14 to 16, the meetings being held in the auditorium on the 21st floor of the new Insurance Exchange Bldg. In the annual address, the President (W. H. Merrill) pointed out that the public still fails to recognize the economic aspect of fire losses or the fact that the cost falls ultimately upon the public at large. The present membership numbers 2415, as the result of an educational campaign started in 1909, at which time the membership was only about 1320, being in fact a slight decrease below 1908. The election of officers resulted as follows: President, H. L. Phillips, Hartford, Conn.; Vice-President, G. M. Robertson, San Francisco, Calif.; Secretary and Treasurer, F. H. Wentworth, Boston, Mass.

The bad reputation of the United States in regard to fire losses and fire prevention was voiced in some of the addresses. Mr. Merrill drew a comparison between this country and European countries, showing the much better conditions in the latter. Mayor Harrison made a similar comparison between Chicago and Berlin, showing for the latter a fire loss and fire-department cost very much less than that of the former. He tried to explain this, however, as being due largely to the fact that Chicago has had a life of only 75 years, but this does not explain the general attitude of public indifference and even opposition. For instance, he made no reference to the fact that in American municipalities there is apt to be greater regard to personal or local (ward) interests than to the interest of the city or citizens as a whole, while in Europe the condition is the reverse of this. Only recently, an attempt to extend the fire limits of Chicago met with vigorous opposition from those interested in districts which are largely built up of frame flats and small dwellings.

A message from Governor Deneen pointed out that Illinois has a State Fire Marshal, this office being established in an endeavor to reduce the fire losses of the state. His attitude was more aggressive than that of Mayor Harrison in regard to comparisons with conditions in Europe, and he stated that in Chicago the annual fire loss is 47 times as great as that of Berlin. In Illinois, the property loss for 1911 was about $11,000,000. Further, 50% of the loss in this country is preventable and should be prevented, and it is in the furtherance of this idea that state fire departments are being created. The report of the Committee on State Fire Prevention Associations showed that in several states there is now a State Fire Marshal charged with the investigation of fires and fire risks.

The Committee on Private Fire Departments and Fire Drills presented instructions for the organization and equipment of departments at factories, industrial establishments, department stores, etc. Also drills in similar establishments and at schools and theatres. The Committee on High Pressure Fire Service Systems presented a report relating to the maintenance of such systems in effective condition, and the Committee on Mine Fires (which was established only last year) presented a report outlining the investigations that should be made in regard to underground workings, shafts and surface plant. Abstracts of these we shall publish later. An address by E. P. Heaton (Toronto, Ont.) referred to conditions in Canada, and suggested cooperation between the two countries so that the present "national" standards might become international. A paper on "The Caliber of Fire Streams," by Charles H. Fox (Cincinnati, Ohio) presented a system of standard nozzles calibrated for a certain delivery; in connection with this he showed a pressure gage having three concentric graduations on the dial, so that the one pointer indicates simultaneously the pressure, volume and velocity of discharge.

The report of the Committee on Standard Hose Couplings and Hydrant Fittings for Public Fire Service, referred to the committee's work in keeping this matter before the attention of waterworks and fire-department associations. The importance of such action was pointed out later by Mr. Griswold (of this committee) in regard to a brief report by the Committee on Private Fire Supplies from Public Mains. In one particular case, the insurance authorities had declared that unless a certain make of meter was used at a private connection the insurance on that property would be canceled, whereas it is very certain that other meters would be equally good. It should be the policy of the insurance and fire-protection interests to coöperate with the water companies and not antagonize them by such arbitrary requirements.

The report of the Committee on Standards related to requirements for standpipes in the interior of buildings, which standpipes (unlike those on the exterior) can be kept full of water without danger of freezing. The two reports of the committee on Automatic Sprinklers and Fire Pumps presented various changes in detail in the present rules and requirements of the association. The Committee on Hydrants and Valves presented specifications for hose valves.

The report of the Committee on Fire Hose stated that the association's specifications had been approved by the National Association of Fire Engineers, and it also presented information as to specifications for the purchase of material and the proper means of securing proposals by advertising and otherwise. In this connection W. C. Robinson (Chicago) referred to a recent article in ENGINEERING NEWS dealing very fully with this latter subject. Mr. Wentworth (Boston) referred to a recent municipal publication which advised purchase without specifications, for the singular reason that specifications were said to be prepared in the interests of individual manufacturers and do not ensure first-class material. He explained that probably this statement was the result of some city being deceived by tricky specifications, and that the authorities had never heard of standard specifications drawn in the combined interests of the purchaser and manufacturer. For this reason it is important for the association to keep municipal officers and the public informed as to its work. In some cases where ordinances require that proposals for purchase of materials must be advertised for, there is an exemption for purchases below a certain sum, and the ordinance is then evaded by the frequent purchase of small lots (such as fire hose). This usually means the use of such evasion by politicians, and the public should be kept informed as to the evil results of such practice.

The Committee on Fireproof Construction made a brief report of progress, stating that it had been delaying action purposely in order to await the completion of the revised New York Building Code; this has been delayed to an unexpected extent, but having now been completed the committee expects to take up its work. The Committee on Cold Storage Warehouses presented specifications for the construction and equipment of such buildings. These prohibited the use of portable lamps, which Mr. Cabot (Boston) considered an impracticable requirement. The Committee on Automobile Garages had a brief report. The report of the Committee on Fire Protection Coverings for Window and Door Openings discussed a classification of fire-retardant coverings, and presented rules relating to interior and exterior openings. The Committee on Gravity Tanks presented a revision in the present rules and also new rules as to small reservoirs of concrete construction. The changes as to steel and wood tanks were accepted, but the matter relating to concrete tanks and reservoirs was referred back to the committee for further consideration.

The Committee on Electric Railway, Light and Power Properties reported that

it considered it inadvisable to attempt to revise the present standards of the association in view of the conflicting standards of the Central Traction and Lighting Bureau and the American Electric Railway Association. Until these can agree upon uniform standards, no progress can be made, and so far it has not been practicable to arrange for a joint conference.

The Electrical Committee submitted some changes in the present rules. The Committee on Fire Prevention Ordinances presented drafts of: (1) a state fire-marshal law; (2) state laws regulating the manufacture, storage, sale, use, and transportation of explosives; (3) a city ordinance governing the manufacture and handling of matches, and (4) city ordinances regulating the manufacture, storage, sale, use and transportation of explosives. These were accepted as information. The Committee on Explosives and Combustibles, in a brief progress report, suggested that the ordinances be submitted to it for consideration. The Committee on Manufacturing Risks and Special Hazards presented information relative to different industries, and a pamphlet of rules and suggestions as to fire prevention at tanneries. Mr. Wentworth (Boston) pointed out that it is impracticable to prepare standards for such special conditions, and that the committee is doing valuable work in preparing information and suggestions for the guidance of those who own and operate plants of this general character.

A message was received from President Taft expressing his approval of the purposes of this association. The Am[erican] Institute of Architects sent a [com]munication showing that a resolution [has] been passed inviting the associatio[n] to send a representative to the next con[ven]tion of the Institute in order to inf[orm] architects as to how they can coöpe[rate] in matters of fire prevention and pro[tec]tion. Two presentations were made; [one] to Mr. Merrill, the retiring Presid[ent] (and Manager of the Underwrit[ers] Laboratories), and the other to Mr. G[eo]dard, who was Secretary of the Und[er]writers Electrical Association from 18[82] to 1911, when it was assimilated with the National Fire Protection Associat[ion]. After the meeting, a visit was paid to the Underwriters Laboratories, which institution was described in our issue of Mar. 30, 1911.

Water Rate Regulation in Wisconsin*

By George C. Mathews†

The Railroad Commission of Wisconsin, which is really a public service commission with comprehensive powers and duties, controls the rates and service of municipally owned as well as privately owned water-works. The commission has taken a notable stand for an equitable division of the cost of water service between the city and private consumers, and also between various classes of private consumers. This paper sets forth some of the principles which have governed the commission in its water rate decisions.

*Abstract of paper on "Wisconsin Water Rates," printed in "Public Service Regulation," January, 1912.

†Expert, Railroad Commission of Wisconsin.

Within the past year the railroad commission of Wisconsin has issued a number of decisions bearing on the subject of cost of water service. The aim of this paper is merely to point out some of the difficulties which have been met and the methods used in fixing rates.

The great majority, in fact, practically all, of the water plants in Wisconsin supply water for general commercial and industrial uses and for fire protection, which necessitates an apportionment of operating expenses between these two classes of service. With the exception of a few plants, water is supplied to some consumers on a flat-rate basis and to others through meters, which makes it necessary to still further divide expenses, in order to determine the reasonableness of each set of rates.

In a general way the steps to be taken in fixing a schedule of rates for water service correspond rather closely to those involved in arriving at rates for an electric or a gas utility, with the added difficulty that in most cases the data concerning demand, pumpage and water consumed are to a large extent inaccurate.

First of all, of course, the adjustment of rates must be preceded by a valuation of the property, which valuation should include not only the value of physical property, but also the various non-physical elements which have been held to constitute proper additions to the value of physical property. After the value of the property has been determined, it is essential that an apportionment be made as between fire protection and general service, so that the rates as finally fixed for each class of service shall make provision for interest, depreciation and taxes upon so much of the property as is chargeable to that service. This apportionment in itself is often sufficient to show the unsoundness of existing methods of charging for hydrant fire service, for it is not at all unusual to find that interest, depreciation and taxes which are chargeable to that service alone constitute more than the entire revenue from the service. The result is that the general water-using public has paid more than its proper share for its uses of water or that the utility has been losing money. Although it is not possible to fix upon a ratio of property values which can be used in any case without an actual apportionment, it has quite generally been found that in cities of from 10,000 to 40,000 inhabitants, about half of the investment in a water-supply plant should be apportioned to the fire service. As a result of this apportionment we have the important items of taxes, depreciation and interest, often more than half of total expenses, apportioned to the service by which they should be borne.

The apportionment of direct operating expenses involve two steps. First, these expenses must be divided into Output, Demand, and Consumer expenses. As explained in decisions of the commission, output expenses are those which vary with the use of water rather than with any other factor; demand expenses are those which are determined by the demand which the utility must meet, and consumer expenses are those caused directly by the fact that consumers are connected.

Demand expenses often constitute about one-half of the total; consumer expenses are only a slight part, and the remainder are output expenses. The methods used in apportioning expenses into these classes need not be discussed here, as we are concerned principally with the apportionment over the two branches of service and the adjustment of rates as a result of that apportionment. Demand expenses are divided between fire and general service on the basis of the maximum separate demands of the two branches.

It is realized that this may not exactly represent conditions as they exist during the period of actual maximum demand at the time of a large fire, but the exact effect of each class of service on the combined peak is difficult of determination, and for practical purposes the separate peaks have seemed to constitute a reasonable basis. Here again we find that no general statement can represent the results of the apportionment under all conditions, although from 40 to 60% of demand expenses are usually apportioned to fire service. Naturally the fire service is charged with very little in the way of output expenses, as very little water is actually used. The expense of this service is due chiefly to the fact that the

utility must at all times be in a position to meet the maximum fire demand. With the exception of hydrant maintenance and a few unimportant items, consumer expenses are all expenses of general service. As a result of these apportionments it is usually found that the cost of fire protection for cities as specified is made up of about half of the demand expenses, and an equal proportion of taxes, interest and depreciation, which is often considerably above the amounts which are being paid for that service. The general practice with water utilities seems to have been to charge a stated amount per hydrant, although there may not be any relation between number of hydrants and cost of service. It seems clear that the proper basis of charging for fire protection is by means of a single charge for all service rendered. The individual hydrant is not the unit of service. It is true that as additional hydrants are set upon the distribution system the utility should receive larger payments, by the amount of interest, maintenance, etc., upon new hydrants, but all such additions are in the nature of consumer costs. When the growth of the protected area increases the actual fire demand, a readjustment should be made of the total charge for fire protection. The practice of charging a stated amount per hydrant installed is an attempt to meet demand expenses and interest, taxes and depreciation, by a charge based upon a unit which does not influence the other expenses and which affects the other expenses only slightly.

Rates for general service are based upon the apportionment which has been made, and should yield sufficient revenue to meet the greater part of output and consumer expenses and the share of demand expenses and of fixed charges which have been apportioned to that class of service. In getting at the rate the next step is the apportionment of interest, taxes, and depreciation among demand, output and consumer expenses. These are usually apportioned upon the basis of the division of total direct operating expenses. With this operation completed, we are ready to make a schedule of rates, but there are two difficulties in the way of a theoretically accurate schedule. The first difficulty is that there is no exact basis upon which to divide demand expenses among the various users. Where meters are in general use the size of meter has been used as a basis, and in other cases the size of service pipe has been employed. Neither of these methods is accurate to the extent that the apportionment of the demand expenses of an electric utility upon the basis of active connected load is accurate. The connected load of an individual water user is theoretically the correct basis upon which to fix his demand charge, but how to obtain a measure of connected load is the difficulty. All that has been done so far has been to make the same demand charge for all users having services or meters of equal size.

A further step in the apportionment of demand expenses might be to charge a greater portion of demand expenses to consumers having two faucets than to consumers having one, and so on up, as the number of faucets increases. This would be satisfactory if all faucets were capable of exercising equal demands, or if the demands could be classified as in the case of incandescent lamps of different wattages. Even if the exact demands cannot be determined, it may be a step in the right direction to make a different demand charge for consumers with different numbers of taps. This method, of course, breaks down when we get beyond the ordinary house faucet, but in case of larger taps it may be practicable to increase the demand charge, not only with the number, but with the size of taps. So far the information available with regard to connected load of metered users has not permitted the use of any such methods.

The second difficulty in the apportioning of demand expenses is that even if the division is based only upon size of meter or of service, assuming that all services of equal size exert equal demands, it is impossible to determine the correct ratios between the demands of services of different sizes. So many factors interfere with the exercise of the full theoretical demands of services that the theoretical ratios are of little value.

When a rate is made for electric current the demand expenses are taken care of by a higher rate for short-hour uses. In the water-supply business this is impracticable. If the water meter would record units analogous to the kilowatt hour and if the connected load or maximum possible demand of a consumer could be determined, the form of rate could be the same as that for electricity. Under existing conditions the most satisfactory form of rate, at least with conditions as they have been found in cases decided by the commission, appears to be a service charge, varying with size of meter, and a charge for water which may decrease as larger amounts are used. If it were possible to include in the service charge all demand and consumer expenses, the rate for water used might be a uniform rate per unit of consumption, but usually it is found best to make the service charge include only the consumer and a part of the demand expenses and provide for meeting remaining demand and all output expenses by the charge for water used.

Where all water used is metered the output cost and such portion of other costs as remains to be met after the service charge is fixed can be divided by the amount sold to arrive at the proper charge per unit of sales, but when, as is much more frequently the case, only a part of the consumers are supplied on a meter basis it becomes necessary to estimate how much water would be used if all services were metered. It has been established beyond all question that more water will be used under a flat-rate schedule than under a properly adjusted meter rate. Where a considerable part of the consumers are supplied on a flat-rate basis, the determination of amount of water actually used becomes largely a matter of estimate. In fact, in most cases where it is desired to put all users on meters where the flat-rate system has prevailed, the results obtained are so much a matter of estimate that the meter schedule as fixed must be regarded as been possible to estimate the use of tentative. In practice, however, it has water under a meter schedule with considerable accuracy.

It is not uncommon to find that complete metering will reduce the use, or at least the apparent use, of water, a half. In such cases it is obviously not sufficient to base the unit charge upon the cost per unit under existing conditions. A decrease of 50% in pumpage will reduce operating expenses to some extent, but not to the same degree that pumpage decreases. It is therefore necessary to determine as closely as possible what reductions will be made in expenses of conducting the business and what counterbalancing expense will be incurred because of the added investment in meters, the cost of reading and maintaining meters, etc., and to base the necessary unit revenue upon the cost as so fixed distributed over the number of units which will be sold under the meter schedule.

What has been said above will indicate in a general way the methods to be employed in fixing the charge for fire protection and the rates for metered water service. No discussion of this subject, however brief, would be complete without reference to a few of the difficulties which have been encountered. Foremost among these is the problem of flat rates. Especially in the northern cities of Wisconsin a relatively large part of the consumers occupy premises which are so constructed that meters cannot be placed in them without danger of freezing. Placing meters in frost-proof boxes would in some cases involve an expense out of proportion to the service supplied. As a result it has been necessary in such cases to continue a flat-rate schedule in effect for such users. The commission has repeatedly pointed out the defects of the flat-rate plan and has urged the installation of meters wherever possible, but probably the flat rate will be used for a long time to come, in supplying consumers who cannot be easily metered. In such cases the apportionment of expenses as between metered and unmetered uses becomes important. If the unit meter charge for water is based upon the amount of water which would be sold

with all services metered, the total revenue will be excessive unless the flat rates are cut so low that they do not pay the cost of service. If meter rates are based upon the amount of water actually used, and flat-rate users made to pay their share, the result will be satisfactory as long as the flat-rate uses continue. If the meter basis is extended, however, the unit revenues will be too low to yield an adequate return with the decreased consumption resulting from the use of meters. As long as both meter and flat rates are in use by the same plant, assuming that the total return is just, neither rate can well be one which would be satisfactory by itself. All this points to the necessity of extending the meter basis of sales as far as possible, but complete metering is probably still a long way off.

Another feature which tends to complicate the problem is the private fire-protection system, supplied from the mains of the utility and consisting of outside protection supplied through hydrants, inside protection supplied through sprinkler systems and hose connections, or both outside and inside protection. In many cases also the fire-protection system is supplied through the same service that supplies the general uses. In regard to fire-protection systems, the commission has ruled that no charge should be made to private users for protection furnished through hydrants, but that this should be made a part of the total charge to the city for fire protection. On the other hand, the commission has held that sprinkler systems and other inside protection should be charged directly to the party to whom the service is rendered, but has as yet not settled definitely upon any basis of charge for use in all cases. In all cases separate services should supply the fire-protection system and the other uses, or else services which supply both should be metered.

What has been said here concerning apportionment of expenses has dealt with direct pressure plants. Where the general service is supplied from a standpipe of capacity great enough so that the pumping station is relieved of the effect of fluctuations in the ordinary demand, except where an unusual demand persists for a day or more, the demand expenses as applied to general service are relatively unimportant, and the question of rates becomes very nearly the same as in the case of a gas utility.

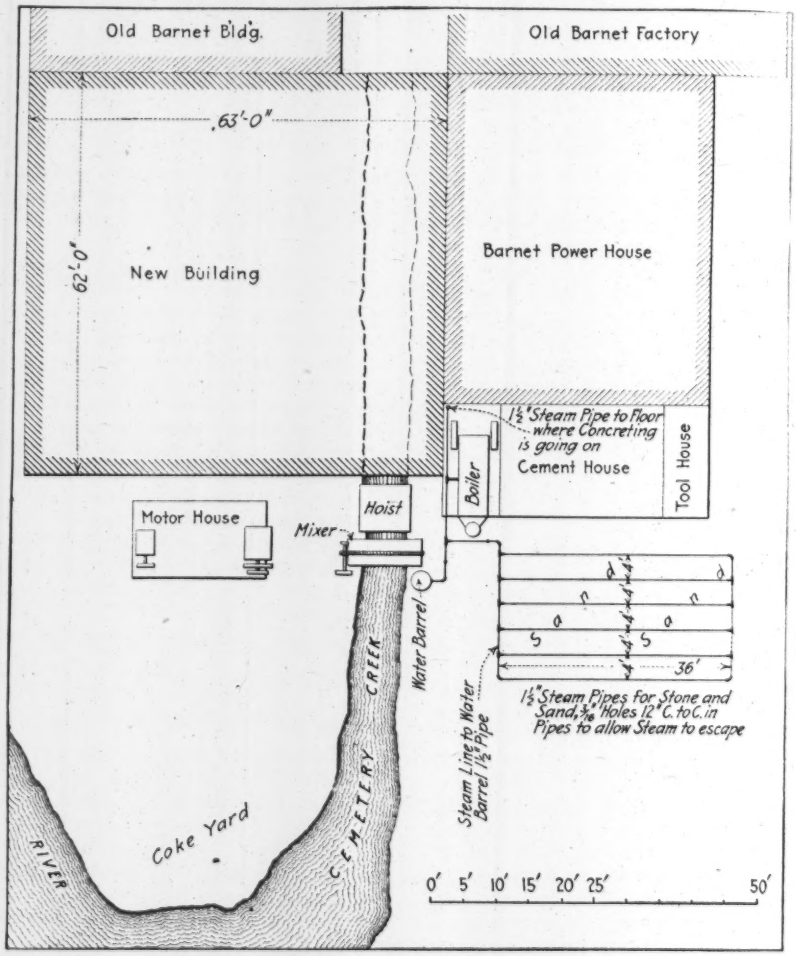
No attempt has been made in this paper to touch upon a number of questions, such as street sprinkling rates, rates for water used in building, etc., which, although they may be important in themselves, are not relatively so. Much remains to be done in the field of water rates, but where a utility can supply the desired information an equitable schedule is not difficult to make; at least a schedule can be provided which is a vast improvement over the majority of those in use.

Rapid Winter Construction of a Reinforced-Concrete Building

By F. E. Schilling*

One of the main objections to reinforced-concrete construction in winter has been the slow progress of the work as ordinarily handled. The demand for a building within a stated time is becoming greater all the while and usually causes an owner to avoid cold-weather construction. If speed in erection can be accomplished and guaranteed, the extra cost of construction in winter is, in many cases, offset by the gain which the owner derives from immediate use of his building. The following is an example of winter construction, necessitated by factory demands, which compares favorably, as regards speed, with the same construction in summer.

The construction of the seven-story reinforced-concrete building for the Barnet Leather Co., Little Falls, N. Y., started Nov. 20, 1911. The footings [illegible] all carried down to rock, which was fo[illegible] at varying depths of from 3 to 16 ft. [illegible] time from Nov. 20 to Dec. 3, 1911, [illegible] taken up by excavation and concre[illegible] footings and columns to the first-f[illegible] level. During this period, the contra[illegible] was very fortunate in having w[illegible] weather, the temperature not falling [illegible] low freezing, except at night. To p[illegible] vent any possible freezing of the co[illegible] crete at night, each day's work w[illegible] covered over with canvas. After the fir[illegible] floor level was reached, the weather turned decidedly colder, although two self-supporting floors were concreted before zero weather was encountered.



Layout of Plant for Mixing and Heating Concrete for Winter Construction of a Reinforced-Concrete Building

The carpenters started to set up the forms for the first self-supported floor on Dec. 1, 1911, and on Feb. 5, 1912, the concrete for the roof was placed. Taking out Sundays and holidays, this allows eight working days per floor. The same building would take practically the same number of days in summer, using only one set of forms. On Mar. 15, 1912, the

*Superintendent of Construction, Turner Construction Co., New York City.

building was ready for occupancy, so that the entire time for construction, during an unusually cold winter, was five days less than four months.

The following plant was installed in order to keep the concrete from freezing, when cold weather set in. An 18-hp. boiler was rented and installed close to the building, as shown in the accompanying sketch. Three lines of 1½-in. steam pipes were run from the boiler; the first line leading to the water barrel at the mixer, the second leading up to the floor which was to be concreted, and the third line leading to a coil of pipes used for heating the sand and stone. This coil consisted of six lines of 1½-in. pipes, 36 ft. long, placed 4 ft. apart and all connected at the ends. All pipes were provided with ⅞-in. holes, spaced 12 in. apart.

The sand and stone brought in by 2-cu.yd. bottom-dump wagons was piled directly on this coil, the area being enough to store 80 cu.yd. of sand and 150 cu.yd. of stone. The steam, when turned on under the sand and stone, escaped through the holes in the pipes and thawed out the material above. During very cold weather the sand and stone were covered over with heavy canvas and with steam turned on underneath, it was found that the material within ten hours was in good shape, the temperature ranging from 60 to 70° F. This was true even in the coldest weather when the sand arrived in large frosted lumps. With a steam pressure of from 25 to 35 lb. at the boiler, the water in the barrel at the mixer would heat up to a temperature of 85° within a few minutes, and was kept at an even temperature by means of a valve on the steam line.

The steam was carried about on the floor forms by means of 1½-in. hose. In this way all the snow and ice on the forms or on the steel was melted. When concrete was poured on the floors, this hose was kept going at full pressure all day. The hose was lowered into each column form before pouring in the concrete, and kept there until the preceding column was filled. While filling the floor slab, the hose was kept in the girder or beam directly ahead of where the concrete was poured, and the steam instead of immediately rising would follow along the beam or girder, thus warming up the steel. The concrete when dumped from the carryalls was at a temperature of 50°, so any slight difference in temperature between the steel and concrete would adjust itself when the steel was surrounded and would not lower the temperature of the concrete enough to make it freeze.

In order to keep the concrete from freezing after it was placed in the forms, it was necessary to keep heat around it until it had set. To accomplish this, the contractor purchased enough canvas in pieces 16 ft. square to cover two stories around the sides, and also to cover over one floor after it was concreted. The carpenters, while building their exterior beam forms, nailed a 2x4-in. timber, 10 in. outside of the forms, and the canvas was hung from this timber. This allowed a space of 10 in. outside of the form for heat circulation. Coke burned in salamanders was used to keep the inclosed stories warm. The salamanders were distributed in the proportion of one to each 300 sq.ft. of floor, and at this rate, the temperature under the floor forms was kept between 80 and 90°. The hardest place to heat was found to be the bottoms of the exterior columns and to offset this, two stories instead of one were inclosed with canvas. When the story below the one being filled was inclosed and heated, the contractor found no difficulty in keeping all the columns from freezing.

Small boxes, 4 in. deeper than the thickness of the concrete on the floors, were placed on the floor forms before concrete was poured, and a hole was cut in the form underneath each box. As a portion of the floor was finished up, long 4x4-in. timbers were placed from box to box, old panels and plank were placed to span between the timbers, and the whole area covered with canvas. This left a 4-in. air space between the top of the concrete and the canvas and the heat rising through the holes cut in the forms under the boxes kept this space warm. The specifications for this building called for the finish on the floors to be put in after the windows and walls had been placed, so the concrete was left rough and caused no trouble in covering up.

The coldest day that concrete was placed on any of the floors was Jan. 26, 1912, when the sixth-story columns and the seventh floor were filled. On this day, the temperature at 7 a.m., at time of starting work, was 6° below zero. At 10 a.m., the temperature was zero; at noon, 10° above; at 3 p.m., 12° above, and at 5 p.m., 8° above. All of the concrete placed on this day turned out in good condition. Coke was kept burning in the salamanders under the forms for all floors for at least six days after the concrete was placed. No shores or forms were removed during this time.

In order, therefore, to make speed and keep the men working, two sets of forms were necessary. Usually on the day following the concreting of a floor, no work was attempted on the next story. It was found, however, that by allowing two nights and a day heating, the concrete was hard enough on top to work on, so the covering over the top was removed and work was started on the next story. Thus while the second set of forms were being set up above, the forms still remained under the floor below, which was inclosed and heated. In this way, it was only necessary to stop work one day for every floor.

The additional cost of building in winter is a factor which must be taken into consideration. The efficiency of the workmen is, of course, not as great as it is in warmer weather. The cost of the installation of a boiler with its steam pipes and hose; the cost of coke, salamanders, canvas and the lumber for extra forms, all increase the cost of a building in winter. There is also the extra cost of labor involved in hanging canvas, shoveling snow, steaming material and keeping fires going, that is all done away with in summer. However, an owner in many cases needs a building in a hurry, and the above is an example of what can be done in regard to speed of erecting a reinforced-concrete building in winter.

This building was 62 ft. by 63 ft. in plan; the floors, of beam and girder design, were supported by reinforced-concrete columns throughout. All interior columns were square, the reinforcement being vertical steel bars, tied together with horizontal hoops. The floors were designed to carry 150 lb. per sq.ft. uniformly distributed live load, and the roof was designed to carry 50 lb. per sq.ft. live load. The building was put up in what is known as the skeleton style of construction; that is, the columns and floors were all concreted and the forms removed before the openings between the wall columns were filled in. The brick curtain walls were 8 in. thick with 6-in. reinforced-concrete sills. All windows were steel sash and extended across the entire space between the wall columns wherever the light was needed. The building was erected by the Turner Construction Co., of New York City and Buffalo, under the direction of Linn Kinne, of Utica, architect. The writer was superintendent in charge of the work.

A Sanitary Survey of the Missouri River drainage area is to be made under the conditions and of the scope stated below. For this information we are indebted to Dr. Rupert Blue, Surgeon-General Public Health and Marine-Hospital Service, Washington, D. C., who has responded as follows to our request for an authentic statement on the subject:

Passed Assistant Surgeon A. J. McLaughlin has been detailed to make a survey of the Missouri River water shed in relation to the prevalence of water-borne diseases and the measures necessary to prevent their spread from one State to another. (On page 36 of the Annual Report of the Service for 1911 appears an outline of the scope of like investigations relating to the Great Lakes). During the course of his investigations, Dr. McLaughlin will consult with State and municipal health authorities and secure their coöperation in so far as possible. The investigations have been undertaken at this time at the instance of the State Board of Health of Kansas, the Governor of that State having appointed a commission to coöperate with commissions from other States in a study of the sanitary condition of the Missouri River. It is expected that Dr. McLaughlin will have all the coöperation it is practicable for the different States to render in his investigations. He has been instructed to confer with the State Boards of Health of Iowa, Missouri, Kansas, Nebraska and North Dakota.

Notes from Engineering Schools

CORNELL UNIVERSITY — Rand Hall, which is now nearing completion east of the present mechanical laboratory of Sibley College, is to be opened with formal exercises on May 23. This is a workshop building erected by a gift of $60,000 from Mrs. F. O. R. Lang, of Montclair, N. J., as a memorial to Jasper R. Rand, Jasper R. Rand, Jr., and Addison R. Rand. The building is three stories high, 170 ft. long and 50 ft. wide. The framework is of steel with concrete fireproofing; the upper floors and the roof are of concrete, with pilasters, cornices and curtain walls of gray wire-cut brick, so that the color of the structure will harmonize with the main building of Sibley College. Space between pilasters is practically filled with steel sash and the roof carries a saw-tooth skylight. Machinery now in the old pattern and machine shops will be moved to the new building.

WORCESTER POLYTECHNIC INSTITUTE—The legislature of the State of Massachusetts, on Apr. 30, passed an act granting to the Institute the sum of $50,000 annually for 10 years, commencing Sept. 1, 1912. The grant is without condition for the first five years, after which it is on condition that the Institute shall have raised $350,000 by Sept. 1, 1917. Hon. Chas. G. Washburn, President of the Board of Trustees of the Institute, has already pledged $50,000 toward the necessary sum.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY—It has been announced that a gift of $750,000 has been made by the will of C. H. Pratt, late of Boston, to establish a "Pratt School of Naval Architecture and Marine Engineering," supplanting the present department of similar name.

RENSSELAER POLYTECHNIC INSTITUTE—A course in the design of motor trucks has been arranged for the department of mechanical and electrical engineering and includes the theory of current practice in design and a laboratory course to study actual performance. An electric motor truck has been installed in one of the laboratories.

The trustees have decided to make athletics compulsory for freshmen from next September and it is expected that after then athletics will be compulsory during the first two years of all courses.

A Mine Cave-In killed seven men at the Norrie mine near Ironwood, Mich., May 13. Six others were imprisoned in the mine at the 2000-ft. level for 24 hours before being rescued. They were kept alive, reports state, by food and air supplied through a pipe or drill hole.

A Railway Collision on the Northern Ry. in France, May 18, near the Paris Gare du Nord caused the death of 13 persons and the injury of 45 others.

A Forest Fire in Washington, May 14, devasted 6 sq.miles of timber land. Seven men were burned to death.

A Powder Mill Explosion at Hazardsville, Conn., May 13, at 8:30 p.m., wrecked one of the wheel mills of the Dupont powder company. No one was injured.

The Powder Magazine of the U. S. Cartridge Co., at Perth Amboy, N. J., exploded at 7:40 a.m., May 17. No one was injured. In a similar explosion at this plant, Jan. 24, one girl in the loading room was killed.

The Stepless-Type of Street Car developed by the New York Railways Co., and described in our issue of Apr. 11, 1912, will be put in extensive service as the result of the experimental use of the sample car already described. It is reported that 150 new cars of this type have recently been ordered and that they will be placed in service by fall.

The Electric-traction Zone of the New York, New Haven & Hartford R.R. will soon be pushed through to New Haven from its present eastern end at Stamford. It has been anounced that contracts for the concrete foundations for the supports of the catenary construction, amounting to several hundred thousand dollars, have been let to the Jobson Gifford Co., of New York. Contract has been closed with the Westinghouse Electric Mfg. Co. for 24 new single-phase electric locomotives for service on this line. These will be of the single-phase colonial type, described in Engineering News, Mar. 14, 1912. The new locomotives, however, will not be equipped with direct-current auxiliary control since they will be used exclusively between New Haven and New Rochelle and on the Harlem River branch to 138th St., New York City. It is expected that the extension of the zone will be completed by the end of 1912.

New York Subway Planning—The recent studies of the Public Service Commission and a committee of the Board of Estimate, New York City, resulted in definite allotment of certain new lines to the Interborough Rapid Transit Co. and certain others to the Brooklyn Rapid Transit Co. After negotiations with the former company, the river-tunnel part of the allotment was arranged in such a way as to give the Interborough a new tunnel location as follows: From West Broadway and Park Place, Manhattan, easterly through Park Place, Mail St., Spruce or Beekman St., Old Slip, and under the East River to Clark St., Brooklyn, thence through Fulton St., and to a junction with the present Brooklyn extension of the existing subway. The west end of this tunnel joins the new West Side tunnel (Seventh Ave. south from the existing subway at 42d St.). The Brooklyn Rapid Transit Co. was assigned a new tunnel location at the south tip of Manhattan Island: Leaving the new Broadway-Church St. subway at Whitehall St., under the East River to Montague St., Brooklyn, and along Montague and Willoughby Sts. to Fourth Ave., where connection will be made to the Fourth Ave. subway. This tunnel route will not only be the Brooklyn outlet of the Broadway subway allotted to the Brooklyn Rapid Transit Co., but it will also receive a connction from the Center St. Loop subway, to be extended southerly from the Municipal Bldg. through Nasau and Broad Sts. The Brooklyn Rapid Transit Co. will also be authorized to build a track connection from the Manhattan Bridge branch of the Center St. Loop subway to the new Broadway subway at Canal St., thus giving the important Broadway subway two outlets to Brooklyn.

A Final Decree in the famous Peoria electrolysis case has been handed down by Judge A. L. Sanborn, of the District Court for the Northern District of Illinois. This suit was first brought in 1904 to secure relief from damage due to electrolysis of water pipes by current escaping from street-railway tracks. The decision given in October, 1910 (see Eng. News, Nov. 17, 1910). It will be recalled that the decision of Judge Sanborn previously noted practically ordered the railway and water companies to cooperate in bringing the damage to an irreducible minimum. The decree now entered orders that, one year after date, the railway company (defendant) shall be enjoined from injuring the water pipes and structures of the Peoria Water Co., by the escape of electric current from rails, structures, etc. The water company must permit the railway company to inspect the mains, service pipes, hydrants, etc., to determine whether injury from electrolysis is being continued, to measure the flow of current on the piping system and for such other matters as may be necessary to determine whether or not the defendant is complying with the decree. The court retains jurisdiction of the case for enforcing its decree and either party may apply to the court for further orders or directions. Within six months after the expiration of the specified year the defendant may apply for a hearing on the question of whether an order should be made directing the water company to permit the railway company to make experimental use of the so called drainage system, by which the rails and the water pipes are connected. Each party is directed to pay one-half the court costs.

A Suit against a Contractor by the U. S. Government for $125,000 damages for failure to sign a contract was decided in favor of the contractor on May 13. The suit was brought against the Illinois Surety Co. and the P. J. Carlin Construction Co. for the failure of the latter company to sign a contract for seawall, wharves, etc., at Fort Mason, San Francisco. The Surety company guaranteed that the Carlin company would, within 60 days, sign the contract or that the Surety company would pay $125,000 to the Government.

The contractor having refused to sign the contract, the Government readvertised the work and awarded it to the San Francisco Bridge Co., at an increase in cost of $115,000, whereupon the Government sued the Surety company and the contractor. The defense set up was that the bid was not accepted in terms but that the Government made a conditional acceptance, also that the contractor had made a bonafide mistake of $100,000, and that the Government had advertised for work to be done according to a patented method, without notice to the bidders that the same was patented. After the Government had put in its case, on motion of the attorney for the contractor, John C. Wait, the action was dismissed upon the merits, the Court holding that the construction company was justified in refusing to enter into the contract.

An Ice Field Patrol to furnish continual information of the position and movements of icebergs and dangerous

field ice in the North Atlantic has been started experimentally by Secretary Meyer of the U. S. Navy. The scout cruiser "Birmingham" has been ordered to proceed from Philadelphia to a point south of the Grand Banks and report by wireless twice daily. She will mark out the boundaries of the ice field and give frequent reports on the position of icebergs.

Panama Canal Records continue to be broken notwithstanding the gradual closing down of operations. During the month of April, 107,211 cu.yd. of concrete were placed in the Pacific locks, which is about 9500 cu.yd. better than any previous monthly record for concrete output. During the same month of 25 working days one 70-ton steam shovel working in the west borrow pit, Gatun Dam, excavated 64,978 cu.yd., the best monthly record yet. Another shovel here, on May 2, excavated 5554 cu.yd., place measurement, in one day of 8 hr., the best daily record.

The American Niagara Falls were practically dry on Apr. 27, for the fourth time in recorded history. All that day, according to newspaper reports, the American channel in the upper river was little more than a respectable trout stream, and it was possible for venturesome ones to walk from Goat Island to the American shore. As on previous occasions an ice pack, this one extending from the head of the rapids to Lake Erie, was the cause of damming up the flow, which also affected the Canadian Falls to some extent. The same event took place on Feb. 14, 15 and 16, 1909, and a description of the Falls and the difficulties encountered in getting rid of the ice jam at that time may be found in Engineering News of Mar. 4, Apr. 29 and May 20, 1909.

U. S. Government Portland Cement Specifications, adopted on Apr. 30, 1912, have just been issued as "Circular of the Bureau of Standards, No. 33." This specification is the joint product of a number of representatives of the various departmental bureaus. It is essentially the same as the present generally used specification issued by the American Society for Testing Materials except in the methods of determining the normal consistency and time of setting of cement. It contains in addition Dr. W. F. Hillenbrand's suggested methods of chemical analysis of cements, limestones and raw mixtures, as adopted by the Society of Chemical Industry, and the Bureau of Standards' auxiliary specifications for physical analysis, sieves and specific gravity flasks. In all future government work these specifications must be used, by order of the President. Presumably copies may be obtained by writing to the U. S. Bureau of Standards, Washington, D. C.

Personals

Mr. A. B. Manson has been appointed City Engineer of Stratford, Ont.

Mr. J. R. Harrigan has resigned as Vice-President and General Manager of the Des Moines (Iowa) City Ry. Co., to take effect July 1.

Messrs. Joseph Tracy and Henry F. Donaldson have become associated as Consulting Automobile Engineers, with offices at 1786 Broadway, New York City.

Mr. P. F. Weisbrod, formerly Trainmaster of the Canadian Pacific Ry., at Cranbrook, B. C., has been promoted to be Division Superintendent at Moose Jaw, Sask.

Mr. George P. Johnson, General Superintendent of the Western general division of the Norfolk & Western Ry., has been appointed Receiver for the Detroit, Toledo & Ironton R.R.

Mr. Robert H. Chapman, of the topographical branch of the United States Geological Survey, Washington, D. C., has been appointed Administrator of the Glacier National Park in Montana.

Mr. N. M. Johnson, Assoc. M. Am. Soc. C. E., has resigned his position as Superintendent of Construction on the Gatun Locks, Panama Canal, to enter private practice in Middletown, Conn.

Mr. A. B. Stevens, formerly Superintendent at Moose Jaw, Sask., has been appointed Assistant to Mr. F. W. Peters, General Superintendent of the Canadian Pacific Ry., at Vancouver, B. C.

Mr. C. F. Stephens, of St. Louis, Mo., has been elected President of the St. Louis & Santa Fé R.R., surveys for which are nearing completion. The headquarters of the company are at St. Louis.

Mr. J. H. Fraser, General Superintendent of the Detroit, Toledo & Ironton R.R., at Springfield, Ohio, has resigned to become Superintendent of Transportation of the Maine Central R.R., at Portland, Me.

Ex-Governor Samuel W. Pennypacker has been appointed a member of the Pennsylvania State Railroad Commission, succeeding the late Charles Mann, of Philadelphia. The salary of a commissioner is $8000 per annum.

Mr. John J. Nolan, formerly General Manager of the Evansville (Ind.) Public Service Co., has been appointed General Superintendent of the Evansville & Southern Indiana Traction Co., succeeding Mr. L. C. Shipherd, resigned.

Mr. W. P. Wiltsee, M. Am. Soc. C. E., formerly Assistant to the Engineer of branch lines of the Norfolk & Western Ry., has been appointed Assistant Engineer in charge of the Norfolk terminal of the company, with headquarters at Norfolk, Va.

Mr. John W. Eber, formerly Division Engineer of the New York Central & Hudson River R.R., at Utica, N. Y., has been appointed General Superintendent of the Toronto, Hamilton & Buffalo Ry., with headquarters at Rochester, N. Y., succeeding Mr. H. H. Adams, resigned.

Mr. M. J. Drury, Mechanical Superintendent of the Western lines of the Atchison, Topeka & Santa Fé Ry., at La Junta, Colo., has been appointed Superintendent of Shops with headquarters at Topeka, Kan., succeeding Mr. John Purcell, promoted, as noted in our columns of last week.

Mr. R. H. Whitten, Librarian of the New York Public Service Commission, First District, sailed from Boston, Mass., on May 18, for England, where he will devote four months to special investigation of British public service corporations in the interests of the National Civic Federation.

Mr. Louis H. Evans, M. Am. Soc. C. E., until recently engaged by the Association of Commerce, of Chicago, Ill., in an investigation of the electrification of the Chicago railway terminals, has been appointed Chief Engineer of the New Orleans Terminal Co., New Orleans, La. Mr. Evans was formerly Chief Engineer of the Chicago Junction Ry.

Mr. C. H. Rust, M. Am. Soc. C. E., whose resignation as City Engineer of Toronto, Ont., was noted in our issue of May 2, was tendered a farewell dinner by 100 members of the Canadian Society of Civil Engineers, of which he is a Past-President, on May 10. During his term as City Engineer he has had charge of the expenditure of $25,000,000, and many complimentary remarks were made on his honest and efficient administration.

Mr. Edmond D. Bronner, Superintendent of Motive Power of the Michigan Central R.R., has been appointed General Manager, succeeding Mr. R. H. L'Hommedieu, whose resignation was noted in our columns of last week. Mr. Bronner was educated in the public schools of Buffalo, N. Y., and at the United States Naval Academy. He entered the service of the Michigan Central R.R. as a draftsman in the car shops at Detroit, Mich., in 1883. He was promoted to foreman, master car builder, Assistant Superintendent of Motive Power and in 1900 to Superintendent of Motive Power.

Mr. Alfred E. Kornfeld, who has been for 19 years an important factor in the upbuilding of Engineering News, retires from its staff with the close of the present month and leaves with his family for Europe on May 28, to enjoy a long vacation.

Beginning in the service of Engineering News as an advertising representative, Mr. Kornfeld has for years been the active Business Manager of the company, and has formed a wide circle of friends throughout the engineering world. Members of the Engineering News staff assembled at a luncheon in honor of Mr. Kornfeld at the Machinery Club, in New York City, on May 15, and he was presented by his associates with a silver loving cup.

Mr. Kornfeld retires from the service of Engineering News with the cordial esteem of his associates, and of the entire organization of which he has so long been an important part. While he ceases active work for Engineering News, he retains a large financial interest in the Hill Publishing Co.

Obituary

Nathaniel Hugh Ross, a former superintendent of construction of the Otis Elevator Co., died at his home in Brooklyn, N. Y., on May 12. He was born in 1848 and served in the 25th Regiment of New York Cavalry during the Civil War.

M. A. Cleveland, contractor for sections of the New York State Barge Canal, and for much work on Welland Canal, the Pittsburg, Cleveland & Toledo R.R., and other large undertakings, died at his home in Brockport, N. Y., on May 19.

Wilbur E. Richardson, President of the Richardson-Phenix Co., of Milwaukee, Wis., died at his home in that city on May 15, aged 52 years. Before establishing the Richardson-Phenix Co., he was for a number of years associated with the Westinghouse Electric & Manufacturing Co., of Pittsburg, Penn., and the Allis-Chalmers Co., of Milwaukee.

R. E. Boswell, Superintendent of Terminals of the Texas & Pacific Ry., at Fort Worth, Tex., was shot and killed by a discharged employee, on May 8. Mr. Boswell was formerly Division Su-

perintendent of the Seaboard Air Line Ry., at Jacksonville, Fla., and had also served as Superintendent of Terminals of the Queen & Crescent Route at Cincinnati, Ohio.

George I. Leland, City Engineer of Lynn, Mass., since 1901, died on May 16. He was born in 1859, and his parents' name was Bailey. He was adopted by Frederick D. Leland, of Milton, Mass., when a small child. He graduated from Dartmouth College, in 1884. For a number of years he served with the engineering staff of the Massachusetts Drainage Commission. He was a member of the Boston Society of Civil Engineers and a prominent member of the Masonic Fraternity.

George Alexander Keefer, M. Can. Soc. C. E., Engineer of the Department of Public Works, New Westminster, B. C., died, on May 19, at Victoria, B. C. He was born at Cornwall, Ont., in 1836, and was the son of the late George K. Keefer, also a civil engineer. His first engineering work was on surveys for the Grand Trunk Ry., between Montreal and Cornwall. Later he served under his uncle, the late Samuel Keefer, M. Can. Soc. C. E., on the Brockville & Ottawa Ry. Subsequently he was Chief Engineer of the Belleville & North Hastings Junction Ry. In 1872 Mr. Keefer entered the service of the Canadian Government and was for a time engaged in surveys on the Canadian Pacific Ry. in the Rocky Mountains. He also took part in the construction of the water-works of Vancouver, B. C., and since had been in charge of numerous public works in the province as Resident Engineer for the Dominion Government.

Engineering Societies

COMING MEETINGS

INTERNATIONAL NAVIGATION CONGRESS.
May 23-28. At Philadelphia, Penn. Secy., J. C. Sanford, 344 The Bourse, Philadelphia, Penn.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 28-31. Spring meeting at Cleveland, Ohio. Secy., C. W. Rice, 29 West 39th St., New York.

AMERICAN WATER WORKS ASSOCIATION.
June 3-8. Annual convention at Louisville, Ky. Secy., J. M. Diven, 271 River St., Troy, N. Y.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.
June 4. Annual convention at New York City. Secy., P. W. Drew, Soo Line, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION.
June 10-14. Annual meeting at Seattle, Wash. Secy., T. C. Martin, 29 West 39th St., New York.

MASTER CAR BUILDERS' ASSOCIATION.
June 12-14. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 390 Old Colony Bldg., Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 17-19. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 390 Old Colony Bldg., Chicago.

CANADIAN ELECTRICAL ASSOCIATION.
June 19-21. Annual meeting at Ottawa, Ont. Secy., T. S. Young, 220 King St., West, Toronto, Ont.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 25-28. Annual convention at Boston, Mass. Secy., F. L. Hutchison, 33 West 39th St., New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 25-28. Annual convention at Seattle, Wash. Secy., C. W. Hunt, 220 West 57th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 26-28. Annual meeting at Boston, Mass. Secy., H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF AUTOMOBILE ENGINEERS.
June 27-29. Summer meeting at Detroit, Mich. Secy., C. F. Clarkson, 1451 Broadway, New York.

NATIONAL MUNICIPAL LEAGUE.
July 8-12. Annual meeting at Los Angeles, Calif. Secy., C. R. Woodruff, North American Bldg., Philadelphia, Penn.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
July 11-12. Summer meeting at Detroit, Mich. Secy., W. W. Macon, 29 West 39th St., New York.

OHIO ELECTRIC LIGHT ASSOCIATION.
July 16-19. Annual convention at Cedar Point, Ohio. Secy., D. L. Gaskill, Greenville, Ohio.

American Society of Engineer Draftsmen—The first woman to be elected a member of this organization was admitted to junior membership at the meeting of May 16, in the Engineering Societies' Building, in New York City. Miss Marie Oberlander, the new member in question, is a student of architectural drawing, at Teachers College, Columbia University.

American Road Builders Association—At a meeting of the board of directors held, May 10, in New York City, it was voted to withdraw from further participation in the joint road congress which had been planned with the American Association for Highway Improvement, the American Automobile Association and the National Association of Road Material and Machinery Manufacturers. This action comes as the result of friction in the executive committee, made up of members of the different associations, which was created to manage the congress.

The nature of the friction in the executive committee is indicated by the following extract from a letter signed by Nelson P. Lewis and Harold Parker, who were appointed to investigate the matter for the Road Builders Association:

> This committee organized, elected a chairman, to whom it delegated certain specific duties and authority, and made other appointments of officials. On Apr. 16, a majority of this committee met, and, although the chairman was absent, reorganized the committee, rescinded all previous action, and elected permanent officers of the congress. The president, secretary and treasurer of the congress so elected each occupies a corresponding office in the American Association for Highway Improvement.

Society of Municipal Engineers of Montana—The purpose of this Society, which was organized at a meeting held at Helena, Mont., May 10, is given as the advancing of the interests of engineers in that state and the diffusion of knowledge derived from the experiences of the members. Efforts will also be made to safe-guard the municipalities of the state against the employment of irresponsible engineers. The officers elected were as follows: President, Henry Gerharz, Billings; Secretary-Treasurer, C. W. Helmick, Helena; Vice-President, C. C. Widener, Bozeman; Directors, M. L. Morris, Great Falls, and W. M. McLean, Lewistown.

American Water Works Association—The program of papers to be presented at the 32d annual convention, at Louisville, Ky., June 3 to 8, 1912, is as follows:

June 4, 8 p.m., "Ancient and Modern Water Works," Edward Wegman; "Floor Area Units as a Basis for Estimating Consumption," William W. Brush.

June 5, forenoon—"Ice Trouble at Buffalo, N. Y." Henry W. Lyon; "A Method of Increasing Depth of Large Wooden Settling Tanks," A. H. Meyers; "How We Crossed Two Streams with Ward Pipe at Rome, Ga.," M. L. Worrell. Afternoon—"More than Fifty Years' Reminiscences on Water Works," H. G. H. Tarr; "Progress of the Adoption of the Nashville Standard Hose Coupling and Hydrant Outlet," F. M. Griswold; "Organization of the Bureau of Water Supply of the City of New York," L. M. de Varona; "Philosophy of Purchasing Supplies," E. C. Church; "Efficient Management," Harrington Emerson.

June 6, forenoon—"Steam Turbines and Centrifugal Pumps," W. O. Berg; "The Cost of Water, or Is It Worth While to Stop Waste," Edward S. Cole; "Method and Cost of Locating, Measuring and Repairing Leaks in Distribution Systems at Lancaster, Penn.," F. H. Shaw; "Results of Chlorination at Cleveland, Ohio," D. D. Jackson; "Hypochlorite Sterilization at Kansas City, Mo.," S. Y. High. Afternoon—"Water Softening at Owensboro, Ky.," E. H. Breidenbach; "Electrolysis from Stray Railway Current," Albert F. Ganz.

June 7, 9 a.m.—"To What Degree Must Water Be Purified?" Chester G. Wigley; "A Reliable Quantitative Test for B. Coli," Shepperd T. Powell; "Currents in Tropical Lakes," John R. Downes; "Wood Stave Water Conduits at Atlantic City, N. J.," L. Van Gilder; "What Is a Fair Rate for Cities," Alexander Potter.

American Institute of Electrical Engineers—The annual meeting of the Institute was held in New York City on the evening of May 21. The result of the recent balloting for the election of officers for the year 1912-13 was announced. The list is as follows: for President, R. D. Mershon, of New York City; for Vice-Presidents, W. S. Murray, of New Haven, A. W. Berresford, of Milwaukee, and S. D. Sprong, of Brooklyn; for Managers, C. A. Adams, of Cambridge, Mass., W. B. Jackson, of Chicago, J. F. Stevens, of Philadelphia, and William McClellan, of New York City. The Secretary, F. L. Hutchinson, and the Treasurer, G. A. Hamilton, were reëlected.

The constitutional amendment providing for an additional higher grade of membership to be known as Fellows was adopted by a vote of 2800 for and 572 against, the total vote representing 45% of the membership and the favorable vote being 83% of the total valid ballots cast.

The amendment making the office of secretary appointive instead of elective was adopted by a vote of 3044 for and 208 against, the total vote representing 45% of the membership and the favorable vote being 92% of the valid ballots cast. In the balloting for both amendments, the number of disqualified ballots was very heavy (over 15%).

A bronze bust of Joseph Henry, by Herbert Adams, was presented to representatives of the Associazione Elettrotecnica Italiana as a token of appreciation for the gift to the Institute of a bronze bust of Galileo Ferraris and in partial recognition of courtesies extended at the recent International Electrical Congress in Turin. Addresses were made by the President, Gano Dunn, and M. I. Pupin for the American Institute, and by Philip Torchio for the Associazione.